

**SECTION 601**  
**METAL WATER SERVICE LINES**

**601.01 DESCRIPTION**

This work is constructing steel and copper water service lines, 1/2-inch through 2-inch (13 mm through 50 mm) nominal diameter.

**601.02 MATERIALS**

Furnish materials meeting the following Subsection requirements:

Seamless Steel Pipe.....	709.09
Copper Pipe .....	709.10

**601.03 CONSTRUCTION REQUIREMENTS**

Install water service lines, make all connections, and pressure test the system meeting the requirements of the Montana Public Works Standard Specifications, and the contract.

Meet the requirements of Section 207 for trench excavation, foundation preparation, and backfilling.

**601.04 METHOD OF MEASUREMENT**

Water service lines are measured by the foot (meter).

Excavation is measured by the cubic yard (cubic meter) under Subsection 207.04.

**601.05 BASIS OF PAYMENT**

Payment for the completed and accepted quantities is made under the following:

<b><u>Pay Item</u></b>	<b><u>Pay Unit</u></b>
Water Service Line	Foot (meter)
Excavation	Cubic Yard (cubic meter)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.



## **SECTION 602**

### **REMOVE AND RELAY PIPE CULVERT**

#### **602.01 DESCRIPTION**

This work is removing pipe culverts from the specified locations, salvaging and storing, disposing of, or cleaning and re-laying the removed pipe.

#### **602.02 MATERIALS**

Replacement pipe for existing pipe not re-usable is specified in the contract.

#### **602.03 CONSTRUCTION REQUIREMENTS**

##### **602.03.1 Culvert Removal**

Remove pipe culverts without damaging the pipe. Replace pipe that is damaged by removal with equal lengths of pipe, at Contractor expense. The replacement pipe must be the same type and diameter and in equal or better condition than the removed pipe before it was damaged.

Store removed pipe at the specified locations.

Backfill pipe removal locations within the new roadway template section meeting Subsections 203.03.2 and 203.03.3 applicable requirements.

##### **602.03.2 Relaying Culverts**

Clean out pipe to be re-laid of dirt, rubbish, and other materials and relay meeting Section 603 requirements.

##### **602.03.3 Restoration and Maintenance of Existing Pavement**

Restore and maintain existing pavement structures disturbed during the removal or relaying of pipe culverts meeting Subsection 603.03.5 requirements.

#### **602.04 METHOD OF MEASUREMENT**

##### **602.04.1 Remove Pipe Culverts**

Pipe culvert removal is measured by the foot (meter) of pipe removed to the nearest 0.3 foot (0.1 meter).

Excavation required to remove pipe culverts is not measured for payment.

##### **602.04.2 Relay Pipe Culverts**

Relay pipe culvert is measured by the foot (meter) along the flowline of the re-laid lengths.

Excavation required to relay pipe culverts is not measured for payment.

#### **602.05 BASIS OF PAYMENT**

Payment for the completed and accepted quantities is made under the following:

<b><u>Pay Item</u></b>	<b><u>Pay Unit</u></b>
Remove Pipe Culvert	Foot (meter)
Relay Pipe Culvert	Foot (meter)

Payment for all costs associated with excavation required for removing or relaying pipe culverts is included in the contract unit price per foot (meter) of remove or relay pipe culvert.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.



**SECTION 603**  
**CULVERTS, STORM DRAINS,**  
**SANITARY SEWERS,**  
**STOCKPASSES, AND UNDERPASSES**

**603.01 DESCRIPTION**

This work is furnishing and installing culverts, storm drains, sanitary sewers, stockpasses, underpasses, further referred to as pipe.

**603.02 MATERIALS**

Furnish materials meeting the following Subsection requirements:

Culvert Sealers .....	707.02
Reinforced Concrete Pipe.....	708.01
Concrete Pressure Pipe.....	708.02
PVC Sewer and Drain Pipe.....	708.05
PVC Water Pipe.....	708.06
Polyethylene Corrugated Drainage Pipe or Tubing .....	708.07
Ductile Iron and Steel Water Pipe.....	709.01
Corrugated Steel Pipe and Pipe Arches .....	709.02
Steel Structural Plate Pipe and Pipe Arches.....	709.03
Bituminous Coated Corrugated Steel Pipe, Pipe Arches, Steel Structural Plate Pipe and Pipe Arches.....	709.04
Pre-coated, Galvanized Steel Culverts and Underdrains ....	709.05
Corrugated Steel Pipe for Underdrains.....	709.06
Corrugated Aluminum Pipe and Pipe Arch Culverts .....	709.07
Corrugated Aluminum Pipe for Underdrains .....	709.08
Seamless Steel Pipe.....	709.09
Slotted Corrugated Steel Pipe .....	709.11

Materials will be acceptance inspected at the manufacturing source.

**603.03 CONSTRUCTION REQUIREMENTS**

**603.03.1 General**

The locations and pipe lengths shown in the contract are an estimate only and may be revised. Order pipe using only the Project Manager furnished list of sizes and lengths.

Repair or replace pipe damaged during delivery, storage, or placing at Contractor expense.

When the contract allows optional types of pipe material for culverts at specific locations, any of the material types shown in the contract may be used for that installation.

Provide the Project Manager in writing, at the pre-construction conference, a list of proposed materials for use at each location optional material is allowed.

The type and quantity of material for bidding is listed in the contract in columns under the heading "Basic Bid Items". The information in these columns is what would be required to complete the planned installation using the "Basic Bid Pipe," which is concrete, when it is an option. If concrete is not an option, steel pipe is the basic bid pipe. Include terminal sections, where required.

Each pipe size is paid for at the contract unit price and is full compensation for the pipe regardless of the pipe optioned by the Contractor. Only work shown in the "Basic Bid Items" columns on the plans is paid for at a given installation, and the quantities are based on

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measurements for the basic pipe. Additional work that is required due to field conditions and not associated with the selected pipe is measured and paid for on quantity changes that would result if the basic bid pipe had been installed. All pay items are measured and paid for based on the basic bid pipe in the contract.

Strut pipe arches if specified in the contract.

**603.03.2 Excavation and Foundation Preparation**

Excavate and prepare the pipe foundation as specified in Section 207.

Place bedding material meeting Section 207 requirements and the Detailed Drawings.

**603.03.3 Installation**

**A. Prefabricated Non-metal Pipe.** Lay non-metal pipe on the foundation in standard lengths starting at the outlet end, with the groove or bell ends up grade. Recess the bell ends into the foundation.

Join the pipe ends to form a positive, tight-fitting joint by applying uniform pressure along the entire circumferential ends of the sections. Place pipe, using methods that prevent pipe damage. Replace pipe damaged during placing at Contractor expense.

Make the joints watertight for round concrete pipe, used for irrigation, storm drainage, or sanitary sewage, or other purposes subject to continuous flow, sealing them with rubber gaskets meeting Subsection 707.02.1. Use flexible plastic joint seal compound for concrete arch pipe joints that meet Subsection 707.02.2 requirements.

The culvert joints for normally dry installations may be sealed with rubber-type gaskets or an approved joint-sealing compound, except where open joints are specified.

Construct angles, turns, and branch connections using pre-fabricated sections or construct as shown in the Detailed Drawings.

Construct pipe dead ends and branches using closed ends or stoppers of equal strength to the pipe wall, cemented to the pipe.

Flared end terminal sections used with concrete pipe may be precast standard sections or cast in place as shown in the Detailed Drawings.

Cap one end of concrete pipe tee sections that connect to median inlets when specified. Use a pre-fabricated cap or construct a cap of reinforced concrete and connect to the tee section forming a watertight joint with a strength equal to the pipe wall strength.

Keep all trenches dry when placing pipe and until the joint filler has cured.

**B. Prefabricated Corrugated Metal Pipe.** Place the pipe on the foundation with each section approximately 1-inch (25 mm) apart. Follow the pipe manufacturer's instructions for connecting joints. Connect the sections with bolted coupling bands shaped to fit the formed pipe. Tap the coupling bands with mallets as the bolts are tightened.

The difference in diameter of abutting pipe ends to be coupled must not exceed 1/2-inch (13 mm).

Do not damage the pipe coating.

Culverts for siphons are designated as "CSP Siphon" or "CSP irrigation".

Construct field joints following the manufacturer's instructions for the type of pipe and coupling bands or devices used.

Construct the field joints for corrugated metal pipe to maintain the pipe alignment and prevent the fill material from infiltrating the joints. Provide circumferential and longitudinal strength using the structural joint performance criteria of Division 2, Section 23 of the AASHTO Standard Specifications for Highway Bridges. Assure the field joints for siphon

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and irrigation pipe installations are watertight and meet Subsection 709.02 requirements. Correct all installations not meeting any of these requirements at Contractor expense.

Conduct all required water-tightness tests on siphon and irrigation pipe installations using MT-420 or an approved procedure.

Cap one end of steel and aluminum pipe tee sections that connect to median inlets. Use a metal cap of equal thickness to the pipe wall and attach it to the tee section forming a watertight joint of equal strength to the pipe wall strength.

Field coat aluminum or Type II aluminized pipe to be in contact with fresh concrete with an asphalt mastic meeting AASHTO M 243 requirements over the full surface to be in contact. The asphalt container's label must provide the following information:

1. Name of Product;
2. Specification;
3. Lot Number;
4. Date of Manufacture;
5. Quantity of Mastic in Container; and
6. Manufacturer's Name and Address.

Separate aluminum pipe coupled to dissimilar metals by either a bituminous-coated coupling, polyvinyl sheeting, painted with rubber-base paints, or use aluminized steel.

- C. Structural Plate Types.** Follow the manufacturer's field erection recommendations and the contract requirements. Do not start work until the Project Manager and Contractor have the manufacturer's specifications and instructions at the work site.

Do not place backfill until all plates in a ring are complete and all bolts in the structure are tightened to the manufacturer's specifications.

Compact backfill using hand-operated compaction equipment within 6 feet (1.8 m) of the pipe neat lines.

Tighten all bolts in the assembly to the pipe manufacturer's torque specifications.

Long-span structure requirements are specified in the contract.

Match the existing pipe section extensions for existing steel structural plate pipe and pipe arch culverts and stockpasses. Remove beveled ends on existing pipe, install the new pipe sections, and re-install or replace the beveled ends as specified.

Pipe end treatment and slopes are detailed in the contract.

Replace damaged structural plates at Contractor expense.

- D. Ductile Iron Pipe.** Lay pipe to the specified line and grade, installing all appurtenances as specified. Uniformly support the pipe throughout its length, except at joints. Make depressions in the foundation for bells, couplings or other connectors at joints.

Bring the pipe to grade by working the material along the barrel of the pipe, leaving the joints un-supported. Flare, grind, file, or machine the pipe cut ends to make the connections. Prevent foreign material from entering the pipe during the work.

Do not deflect pipe beyond the manufacturer's allowable tolerances.

Inspect fittings for cracks, blowholes, chips, and coating damage before installation. Replace defective fittings.

Lower fittings into the trenches without damaging the inside lining or outside coating.

Install concrete thrust blocks against undisturbed soil.

Make pipe joint connections following the manufacturer's recommendations.

- E. Storm Drain Manhole and Trunkline Connections.**

1. **Concrete Pipe to Manhole and Trunkline Connections.** Install the pipe entering the manhole wall so the pipe end is flush with the inside wall of the manhole as

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shown in the Detailed Drawings. Grout the connection using a commercial non-shrink grout.

2. **Stub Connections to Trunklines.** Place the stub pipe with the pipe end projecting a maximum 2 inches (50 mm) into the trunkline. Contour the projecting end to match the trunklines inside wall. Grout the connection using a commercial non-shrink grout.

**F. Embankment Protectors.** Construct embankment protectors as shown in the Detailed Drawings. Include the flared end section, the 18-inch (450 mm) CMP, the reducer and the bends in the total length of embankment protector.

**603.03.4 Backfilling**

- A. General.** Use backfill material free of sticks, sod, frozen soil, or other deleterious matter. Do not permit stones, rocks, chunks of broken concrete, or other material larger than 3 inches (75 mm) within the top 2 feet (610 mm) of the top of water and sanitary sewer lines and within 1 foot (305 mm) of the pipe top for all other installations.

Replace the top 2 feet (610 mm) of backfill for excavations in existing roadway sections "in-kind".

Place backfill material in maximum 6-inch (155 mm) layers loose thickness and compact. Firmly tamp the backfill under the pipe haunches. Extend the backfill material placed above the excavation limits or the ground line beyond each side of the pipe equal to twice the pipe diameter or 12 feet (3.7 m), whichever is less.

Compact backfill equally on each side of the pipe to at least 1 foot (305 mm) above the pipe top.

Use equipment and methods for backfilling and compacting that do not distort, misalign, or damage the pipe. Replace pipe that is distorted, misaligned, or damaged at Contractor expense.

Do not allow heavy equipment to pass over any pipe until at least 4 feet (1.2 m ) or one-half pipe diameter of backfill, whichever is greater, is placed and compacted over the pipe.

- B. Imperfect Trench Method.** Culvert installation using the imperfect trench method is shown in the Detailed Drawings.
- C. Rock Embankment.** Install pipes placed in blasted or fractured rock embankments as follows:

- Envelope the exposed pipe surface above the level of the bedding trench with graded bedding material.
- Extend the envelope to 1/2 the nominal pipe diameter or 3 feet (915 mm), whichever is greater. Completely surround the pipe with graded bedding material when a bedded trench is not specified.
- Use graded bedding material meeting Subsection 701.04.1 requirements; placed and compacted meeting Subsection 603.03.4(A).

**603.03.5 Restoration and Maintenance of Existing Pavement**

Restore the existing pavement excavated for pipe installation using material equal to or better than the in place pavement. Restoration includes replacing and compacting excavated aggregate base with materials equal to those in the existing roadway and placing new bituminous surfacing equal to the existing, but not less than 0.25 feet (76 mm) in thickness. Place and compact the replacement bituminous surfacing to match the adjacent pavement providing a smooth riding surface, including the joints.

Maintain the restored pavement areas in good condition until the new pavement is placed.



**603.04 METHOD OF MEASUREMENT****603.04.1 Pipe**

Pipe is measured by the foot (meter) in place from end-to-end of the installed structure along the bottom or pipe invert. Gasket material, specified coatings, coupling bands, bolts, bands, fittings, tees, risers, end sections, joint testing, restoring disturbed pavement, flared ends, beveled, skewed, and similar shapes or special designs, riser pipe lengths, riser tee sections and field cast concrete bends and connections are not measured separately but are included in the pipe lengths measured.

Storm drain and sanitary sewer are measured by the foot (meter) from manhole center to manhole center.

Excess pipe installed and not ordered by the Project Manager is not measured for payment.

**603.04.2 Excavation**

Excavation is not measured for payment.

**603.04.3 Bedding and Foundation Material**

Bedding and foundation material is measured by the cubic yard (cubic meter) in place.

**603.04.4 Embankment Protectors**

Embankment protectors are measured by the foot (meter) of installed pipe and include all necessary hardware.

**603.05 BASIS OF PAYMENT**

Payment for the completed and accepted quantities is made under the following:

<b><u>Pay Item</u></b>	<b><u>Pay Unit</u></b>
Pipe (Type and Size)	Foot (meter)
Bedding and Foundation	Cubic Yard (cubic meter)
Embankment Protector	Foot (meter)

Payment at the contract unit price is full compensation for all resources necessary to complete those items of work under the contract.

Payment for all costs associated with excavation, foundation preparation and backfilling is included in the unit price bid per foot (meter) of pipe.

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**SECTION 604**  
**MANHOLES,**  
**COMBINATION MANHOLES**  
**AND INLETS, AND INLETS**

**604.01 DESCRIPTION**

This work is constructing manholes, combination manholes and inlets, and inlets.

**604.02 MATERIALS**

**604.02.1 General**

Furnish materials and precast structures meeting the contract requirements.

**604.02.2 Concrete**

Furnish Class "DD" concrete or equivalent meeting Section 551 requirements, except that precast concrete manhole riser sections must have a minimum 4,000-psi (27.6 MPa) 28-day compressive strength.

**604.02.3 Reinforcing Steel**

Furnish reinforcing steel meeting Subsection 711.01 requirements.

**604.03 CONSTRUCTION REQUIREMENTS**

**604.03.1 General**

Construct and install the structures as specified in the contract.

**604.03.2 Excavation**

The Project Manager will establish the lines and grades for structure excavation.

Compact foundations meeting Subsection 203.03.3 to provide full bearing for the structures.

**604.03.3 Backfill**

Uniformly place backfill around structures in maximum 6-inch (155 mm) deep loose layers, and compact meeting Subsection 203.03.3.

Maintain the established structure lines and grades while backfilling.

**604.04 METHOD OF MEASUREMENT**

Manholes, combination manholes and inlets, and inlets are measured by the unit for each specified type, complete in place. Slotted drain, as shown in the Detailed Drawings, is measured by the foot (meter) and includes the end cap and the elbow connection to the inlet.

Excavation and backfill are not measured for payment.

**604.05 BASIS OF PAYMENT**

Payment for the completed and accepted quantities is made under the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Manhole, Manhole and Inlet, and Inlet	Each
Slotted Drain	Foot (meter)

Payment for all costs associated with excavation and backfill required for manholes, manhole and inlets, inlets, and slotted drains is included in the contract unit price of each respective drainage item.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.



## **SECTION 606**

### **GUARDRAIL AND CONCRETE BARRIER RAIL**

#### **606.01 DESCRIPTION**

This work is the furnishing, installing, removing, replacing and revising metal beam guardrail, cable guardrail, box beam guardrail and concrete barrier rail.

#### **606.02 MATERIALS**

Furnish metal beam guardrail, cable guardrail, box beam guardrail and concrete barrier rail materials meeting the following Section and Subsection requirements:

Steel Beam Guardrail and Fittings .....	705.01.1
Wood Guardrail Posts and Blocks .....	705.01.2
Wire Rope and Connecting Hardware .....	705.02
Concrete Barrier Rail .....	554
Box Beam Guardrail .....	Detailed Drawings
Guardrail Reflectors .....	704 and Detailed Drawings

Furnish all new materials unless otherwise specified.

#### **606.03 CONSTRUCTION REQUIREMENTS**

##### **606.03.1 General**

Install guardrail and concrete barrier rail meeting the Detailed Drawings and contract requirements.

Submit two copies of the manufacturers installation instructions for all guardrail terminal sections and impact attenuators installed on the project, to the Project Manager at least 15 days prior to the installation.

The Project Manager will establish the line and grade for the terminal sections. Establish the line and grade between the terminal sections.

Correct all vertical and horizontal mis-alignment to the specified line and grade at Contractor expense.

Complete the guardrail installation(s) within 48 hours of starting work at all locations exposed to traffic. Where difficult post placement conditions prevent completion in one working day without additional resources, place, at Contractor expense, hazard panels at maximum 50-foot (15.2 m) spacing to delineate partial installation areas when work on those installations is not active.

Excavate the postholes and drive the posts using methods and equipment that do not damage the adjacent pavement.

Stop post driving that heaves the adjacent pavement more than 1/2 inch (13 mm) in 10 feet (3 m), measured using a 10-foot (3 m) straightedge parallel to the pavement.

Level and repair all damaged surfaces around the installed posts.

Use only steel or wood guardrail posts for new metal beam guardrail runs unless wood posts are specified.

Where the contract specifies extending an existing guardrail run, the Contractor may use either the existing post type or other approved post types in the extension. Use the post type specified for terminal sections.

When wood posts and blocks are damaged, cut or bored after treatment, treat the injuries, cuts and holes with three applications of a copper naphthenate solution containing at least two

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percent copper metal or with chromated copper arsenate (CCA) meeting AWWA M4 requirements.

**606.03.2 Installing Posts**

If the posthole is excavated, compact the posthole bottom, insert the post, and backfill and compact around the post in 6-inch (155 mm) loose layers ensuring the material is at optimum moisture before placing and compacting the next layer. Maintain the post line and grade.

Always drive steel posts. Wood and concrete posts may be placed by excavating and backfilling or by driving.

Replace all posts damaged by post driving.

Maintain the post alignment as the posts are driven.

Fill the area between the surrounding ground and the post by backfilling and tamping. Re-compact the loose material around the post and level the area as directed.

Remove, replace or re-install mis-aligned, loose or damaged posts at Contractor expense.

Pilot holes approximately 6 inches (155 mm) in diameter may be used when necessary.

If furnishing steel guardrail posts, meet Subsection 705.01.6. Submit to the Project Manager at least 15 calendar days before installation, two copies of the following:

1. Manufacturer's information detailing dimensions, steel grade, and other pertinent information for the guardrail posts, blockouts, bolts, and all other hardware for the installation;
2. Installation instructions; and
3. Manufacturer's certification that the guardrail system meets NCHRP 350 requirements.

**606.03.3 Metal Beam Guardrail Erection**

Install metal beam guardrail, including the terminal sections and bridge approach sections as shown in the Detailed Drawings and meeting the contract requirements.

Splice the metal rail sections with the lap in the direction of traffic. Locate all rail splices at the posts. Construct splices, laps, and terminal connectors as shown in the Detailed Drawings and meeting the contract requirements. Splice the terminal connectors for attaching the rail sections to the bridge ends by lapping as shown in the Detailed Drawings.

Tighten the bolts through the splices and mounting bolts "snug tight".

Ensure the bolts project at least 1/4 inch (6 mm) beyond the nut. Place the bolt heads on the traffic side of the guardrail.

Paint holes, slots, or cut ends in metal guardrail caused during installation with an approved galvanizing paint. Spot paint all bruised, broken, scaled, or damaged spelter coating on metal parts following the paint manufacturer's recommendations after the guardrail is installed.

**606.03.4 Stiffened Guardrail Sections**

Construct stiffened guardrail sections as shown in the Detailed Drawings.

**606.03.5 Box Beam Guardrail**

Construct box beam guardrail and bridge approach sections as shown in the Detailed Drawings.

**606.03.6 Cable Guardrail**

Furnish and install cable guardrail and terminal sections meeting the Detailed Drawings and the contract requirements. Install the posts plumb without damaging the post and its protective coating. For terminal sections, set the end posts, backfill and machine compact the backfill material in 4-inch (100 mm) lifts.

Install reflectors meeting Section 704 requirements on every other post in the guardrail run excluding posts in the terminal sections that curve away from the driving lanes.

**606.03.7 Concrete Barrier Rail**

Install concrete barrier rail meeting the contract requirements and the Detailed Drawings.

**606.03.8 Reset Concrete Barrier Rail**

Reset concrete barrier rail as specified in the contract.

**606.03.9 Raise Guardrail**

Raise the existing guardrail to the specified height.

Remove the rail elements or cable, and completely remove the post. Backfill and compact the posthole bottom, re-install the posts and compact the backfill around the post meeting 606.03.2, and replace the rail elements or cable to the specified height.

Replace all guardrail materials damaged during the work at Contractor expense.

Correct all horizontal and vertical alignment in the guardrail to the specified line and grade.

**606.03.10 Remove Guardrail**

Remove and salvage the existing guardrail from the specified locations meeting the applicable requirements of Section 202. Replace all guardrail damaged during removal at Contractor expense. Dispose of removed materials not designated to be salvaged.

Load all salvaged guardrail materials from the project, transport and unload it at the specified location or as directed.

Backfill and compact the postholes left from post removal using clean material or crushed base or top surfacing, to the base of the adjacent bituminous surfacing. Apply a light asphalt spray to the hole sides and bottom and backfill with asphalt surfacing. Compact the plant mix surfacing as specified.

Do not cut off and leave existing posts in place.

**606.03.11 Revise Guardrail Elements**

Revise the guardrail elements as specified. The items include but are not limited to bridge approach sections and terminal sections.

**606.03.12 Nested W-Beam Guardrail Sections**

Construct nested guardrail as shown in the Detailed Drawings.

**606.04 METHOD OF MEASUREMENT****606.04.1 Metal Guardrail**

Metal guardrail, excluding terminal sections, is measured by the foot (meter) from center-to-center of the end posts of each section.

**606.04.2 Metal Guardrail Terminal Sections**

Metal guardrail terminal sections are measured by the unit or the foot (meter) as shown in the Detailed Drawings, unless otherwise specified, for each type specified.

**606.04.3 Bridge Approach Sections**

Bridge approach sections, including tapered curbs, are measured by the unit for each type specified.

**606.04.4 Stiffened Guardrail Sections**

Stiffened guardrail sections are measured by the foot (meter) from center-to-center of the end posts of each stiffened section as shown in the Detailed Drawings.

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Box beam guardrail is measured by the foot (meter), excluding the terminal sections, as shown on the Detailed Drawings.

**606.04.6 Box Beam Guardrail Terminal Sections**

Box beam guardrail terminal sections are measured by the unit as shown in the Detailed Drawings for each type specified.

**606.04.7 Cable Guardrail**

Cable guardrail is measured by the foot (meter), excluding the terminal sections as shown on the Detailed Drawings.

**606.04.8 Cable Guardrail Terminal Sections**

Cable guardrail terminal sections are measured by the unit as shown on the Detailed Drawings.

**606.04.9 Concrete Barrier Rail**

Concrete barrier rail is measured by each 10-foot (3.05 m) section. Connections to the existing barriers are included in the cost of the rail.

Measurement does not include those portions of barrier constructed as an integral part of sign foundations.

**606.04.10 Impact Attenuators**

Impact attenuators are measured by the unit as specified in the contract.

**606.04.11 Reset Concrete Barrier Rail**

Reset concrete barrier rail is measured by each 10-foot (3.05 m) section.

**606.04.12 Concrete Barrier Rail Transition**

Concrete barrier rail transitions are measured by each 10-foot (3.05 m) section.

**606.04.13 Concrete Barrier Rail Terminal Section**

Concrete barrier rail terminal sections are measured by each 10-foot (3.05 m) section.

**606.04.14 Raise Guardrail**

Raise guardrail, including terminal sections, is measured by the foot (meter) from center-to-center of the end posts of each section.

**606.04.15 Remove Guardrail**

Remove guardrail is measured by the foot (meter) from center-to-center of end posts of each section removed.

**606.04.16 Remove Concrete Barrier Rail**

Remove concrete barrier rail is measured by each 10-foot (3.05 m) section.

**606.04.17 Revise Guardrail Elements**

Revise guardrail elements is measured by each element revised, as specified in the contract.

**606.04.18 Nested W-Beam Guardrail Sections**

Nested guardrail is measured by the foot (meter), as shown in the Detailed Drawings.



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**606.05 BASIS OF PAYMENT**

Payment for the completed and accepted quantities is made under the following.

<b><u>Pay Item</u></b>	<b><u>Pay Unit</u></b>
Metal Guardrail	Foot (meter)
Metal Guardrail Terminal Section	Each or Foot (meter)
Bridge Approach Section	Each
Stiffened Guardrail Sections	Foot (meter)
Box Beam Guardrail	Foot (meter)
Box Beam Guardrail Terminal Section	Each
Cable Guardrail	Foot (meter)
Cable Guardrail Terminal Section	Each
Concrete Barrier Rail	Each
Impact Attenuators	Each
Reset Concrete Barrier Rail	Each
Concrete Barrier Rail Transition	Each
Concrete Barrier Rail Terminal Section	Each
Raise Guardrail	Foot (meter)
Remove Guardrail	Foot (meter)
Remove Concrete Barrier Rail	Each
Nested Guardrail Sections	Foot (meter)

Revise guardrail elements is paid for under the appropriate bridge approach section or guardrail terminal section.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.



## **SECTION 607**

### **FENCES**

#### **607.01 DESCRIPTION**

This work is constructing, removing and resetting barbed wire, combination barbed and woven wire, chain link fences and gates.

#### **607.02 MATERIALS**

Furnish materials meeting the following Section and Subsection requirements:

Chain Link Fence .....	712.01
Interstate and Farm Fence .....	712.02
Class "F" Portland Cement Concrete .....	551

Fence material acceptance test samples will be taken from the materials delivered to the project.

#### **607.03 CONSTRUCTION REQUIREMENTS**

##### **607.03.1 General Requirements**

Construct fencing before any other work is performed on all parcels of land. This requirement may be waived where the Contractor has obtained a landowner written waiver. The waiver must state a completion date agreed to by the landowner and the Contractor for completing the fence work.

Maintain all existing fence enclosures. Close Contractor fence openings using new permanent fence, or use temporary fence, cattle guards, or watchman where new permanent fence cannot be constructed the same day.

Temporary fence may be used in place of new permanent fence if approved.

##### **607.03.2 Fence Preparation**

Fence preparation consists of removal of vegetative and ground surface obstacles prior to actual fence installation. For fence preparation, clear only those portions of brush, shrubs and vegetation interfering with the fence installation. Cut off, trim or mow interfering vegetation without exposing bare soil in, or adjacent to, streams, stream banks, natural drainages or wetlands. Dispose of the resulting debris, slash, branches, etc. in accordance with subsection 201.03.5. Avoid or minimize injury or damage to remaining vegetation. Do not grub, excavate, grade, or disturb the soil surface, unless in direct conflict with fence wire.

Soil disturbance associated with fence preparation, both inside and outside the construction limits, may not be included in the Storm Water Pollution Protection Plan (SWPPP) permit. If disturbance of soil is unavoidable, revise and update the SWPPP, and install appropriate erosion and sediment control features (BMP's) as required. Prior to fence installation, seed all exposed soil in accordance with the contract requirements. The seeding dates specified in the contract do not apply to this seeding.

Prior to commencing work that alters or disturbs the bed or banks of any stream or its tributaries, obtain authorization from the Montana Department of Fish, Wildlife, & Parks; commonly referred to as the Montana Stream Protection Act authorization (SPA 124).

Prior to conducting any work that results in the placement, or discharge of soils into waters of the United States, including wetlands, obtain a US Army Corps of Engineers Section 404 authorization.

Prior to conducting any work in State waters, including wetlands, that causes an increase in turbidity; obtain a 318 authorization from the Montana Department of Environmental Quality.

Use equipment that minimizes disturbance to soil and vegetation (i.e. low pressure rubber tired equipment, wide tracked low-weight tractors, etc.) in fence preparation areas, for setting fence posts and installing fencing material. If it is necessary to operate equipment in wetlands, place and operate the equipment on mats, or utilize other measures as necessary to avoid or minimize soil and vegetation disturbance. When installing fence posts and fencing, utilize measures, including hand work, to avoid or minimize soil and vegetation disturbance in streams and natural drainages and on, or adjacent to, stream banks.

### 607.03.3 Constructing Chain Link Fence

Construct chain link fence as specified in the contract and meeting the following requirements:

- A. Posts.** Set posts vertically, spaced at maximum 10-foot (3 m) centers, measured parallel to the ground surface.

Set posts for 5 foot, 6 foot and 8 foot (1.5 m, 1.8 m and 2.4 m) fence in concrete. Set end, corner, and pull posts for 3 foot and 4 foot (0.9 m and 1.2 m) fence and line posts connected by bracing to end, corner, or pull posts in concrete. Drive or set in concrete, line posts on 3 foot and 4 foot (0.9 m and 1.2 m) fence as specified.

Use the footing dimensions and post embedment depths shown in the Detailed Drawings. Crown concrete footings to shed water.

Do not damage posts while driving them. Backfill and compact the voids around posts.

Set line posts placed in solid rock without soil overburden, at least 14 inches (360 mm) deep. When in solid rock, set end, corner, gate, and pull posts at least 20 inches (510 mm) deep. Excavate or drill holes to a minimum width or diameter 1-inch (25 mm) greater than the largest dimension of the post being set.

Cut posts to the required length before installing. The Contractor may use an even post length set deeper into the solid rock at Contractor expense.

For metal posts placed in bored rock holes or consolidated soils, set the post plumb and fill the holes with cement grout that meets the requirements of Subsection 713.04. Work the grout into the holes to eliminate voids. Concrete footings are not required where posts are set in bored holes.

Place posts, set in solid rock covered by soil or loose rock, to the specified depths or to the minimum solid rock depths specified above, whichever is less. When solid rock is encountered before reaching the specified depth, construct concrete footings from the solid rock to the top of the ground on 5 foot, 6 foot and 8 foot (1.5 m, 1.8 m, and 2.4 m) fence and on end, corner, and pull posts for 3 foot and 4 foot (0.9 m and 1.2 m) fence. Grout around that part of the post that is in solid rock.

Check that all posts are solid once they are driven, backfilled, or concrete is placed.

- B. Top Rail or Cable.** Pass the top rails through the line post tops, providing a continuous brace from end-to-end of each fence section. Join top rail sections using sleeve-type couplings. Fasten the top rails to the terminal posts using pressed steel fittings.

Replace the top rails with a 3/8-inch (9.5 mm) diameter galvanized steel cable when fences are placed within 50 feet (15.2 m) from the edge of the nearest driving lane.

- C. Fence Fabric.** Place chain link fabric for 6 foot and 8 foot (1.8 m and 2.4 m) fence on tangents, on the post face away from the highway. On 3 foot, 4 foot, and 5 foot (0.9 m, 1.2 m, and 1.5 m) fence, place the fabric as directed. On curves, place the fabric for all fence heights on the outside face of the posts on curves.

Place the chain link fabric on a straight grade between posts, leveling high points on the ground. Obtain the Project Manager's approval to fill in depressions along the fence line.

Stretch taut and securely fasten the fabric to the posts. Stretching by motor vehicle is prohibited. Use stretcher bars and fabric bands spaced at 1-foot intervals (305 mm) to fasten to end, gate, corner, and pull posts. Cut the fabric and attach each span independently at all pull and corner posts. Fasten fabric to line posts at 14-inch (360 mm) intervals with tie wire, metal bands, or other approved fasteners. Fasten the top edge of the fabric to the top rail or cable with tie wires spaced at 18-inch (460 mm) intervals.

Join rolls of wire fabric by weaving a single strand into the ends of the rolls forming a continuous mesh.

When a winged cattle guard is located in a chain link fence, extend the wire fabric beyond the post supporting the wing and securely fasten it to the wing.

- D. Tension Wire.** Attach a tension wire to the bottom of the chain link fabric using ring fasteners at 24-inch (610 mm) maximum intervals and secure at the terminal posts or pull posts using brace bands.
- E. Gates.** Fasten chain link fabric to the gate frame end bars using stretcher bars and fabric bands, and to the top and bottom of gate frame bars using tie wires for the chain link fence, or by other approved standard methods.

Clean welded connections on steel gate frames with burned spelter coating by wire brushing, to remove all traces of the welding flux and loose or cracked spelter. Paint the cleaned areas with two coats of zinc oxide-zinc dust paint mixed in a weight ratio of one part zinc oxide to four parts zinc dust.

Provide the drop-bar locking device for double metal gates with a 12-inch (305 mm) square by 15-inch (380 mm) deep Class "F" concrete footing crowned at the top. Provide a minimum 6-inch (155 mm) hole in the footing to receive the locking bar.

- F. Panels.** Install panels as shown in the Detailed Drawings.

Double panels at fence corners and angle points consist of one corner post, two line posts, two braces, two truss rods, two top rails, concrete, and other fixtures. Single panels at gates and fence ends consist of one gate or end post, one line post, one brace, one truss rod, one top rail, concrete, and associated fixtures.

#### **607.03.4 Constructing Barbed and Woven Wire Fences**

Construct barbed and woven wire farm and Interstate fences meeting the contract requirements and the following.

- A. Posts and Braces.** Excavate post holes, footing excavations, and anchors as shown in the Detailed Drawings.

Wood posts may be driven. Repair or replace all damaged posts at Contractor expense.

Treat cut or trimmed areas on posts and braces with three applications of a copper naphthenate solution containing a minimum of 2 percent copper metal or with chromated copper arsenate (CCA) meeting AWWA M4 requirements.

Securely nail braces to terminal and brace posts.

Metal posts not specified to be set in concrete may be driven. Place and grout metal posts placed in rock as specified.

Backfill and compact post hole material in 6-inch (155 mm) loose lifts.

Dampen holes before placing concrete. Assure the concrete has set before placing and stretching the fence wire or attaching gates to the posts and braces.

**B. Placing Wire.** After the posts, braces, and footings are set, place the woven wire and/or barbed wire, stretch it tightly, and fasten to the posts.

Apply tension following the wire manufacturer's recommendations with a mechanical or other approved wire stretcher. Do not use motor vehicles to stretch fence.

Diagonally drive U-shaped staples across the wood grain so both points enter different grains. Where wire uplift occurs, drive staples with the points slightly upward. On level ground and over knolls, drive staples slightly downward. Staple the wire tightly at corner, end, and pull posts. The staples on line posts must allow wire movement without damaging the wire.

Place "deadman" as shown in the Detailed Drawings at grade depressions, alignment angles, and other places where stresses might pull posts from the ground or out of alignment.

Install one metal line post in each 500-foot (152.5 m) wood post fence run and in smaller runs between gate post ends for lightening protection.

Construct gates as shown in the Detailed Drawings meeting Subsection 712.02 requirements.

#### **607.03.5 Temporary Fence**

Erect temporary fence to keep livestock and traffic out of the work area. Temporary fence may remain in place only during the work or until the fence is directed to be removed.

Use Type F3M as temporary fence for livestock enclosures. Construct all temporary fence from metal posts and materials meeting Section 712. Use the minimum number of braces, panels, deadman, and other accessories for constructing temporary fence.

Undamaged material used in the temporary fence that meets specifications may be used in the permanent fence. Material not used in permanent fencing remains the Contractor's property.

Remove temporary fence at Contractor expense.

#### **607.03.6 Remove and Reset Fence**

When removing and resetting a fence, furnish all required materials over and above the usable salvaged fence that are new materials meeting Section 712 requirements. Required new materials are listed in the contract. Use, to the extent practical, materials of the same type and quality as those of the old fence that meet of Section 712 requirements.

Replace rotten, damaged, or broken posts and rusty, unusable wire with new material. Do not use any galvanized materials with abraded or broken coating.

Furnish all additional fence wire required for depressions.

Carefully handle and stockpile, at designated locations, all removed fence determined to be salvageable.

### **607.04 METHOD OF MEASUREMENT**

#### **607.04.1 New Fence**

Chain link, Interstate, farm, and temporary fence are measured by the foot (meter) to the nearest foot (0.1 m). The measurements are made on the fence line along the top wire or rail or along a line parallel thereto, from end post to end post including wing fences to structures. Gates, cattle guards, or other openings are measured separately. Double sections of fence erected across depressions are measured for payment. All other temporary closures are included in the measurement of temporary fence. Temporary fence materials ordered by the Contractor but not used in the work will not be measured or paid for. Temporary fence removal is not measured separately.

**607.04.2 Remove and Reset Fence**

Remove and reset chain link, Interstate, and farm fence is measured by the foot (meter). Measurement of reset fence in place is made under Subsection 607.04.1.

New posts and wire required to reset the removed fence is measured as follows:

1. Wood and metal posts are measured by the unit;
2. Barbed wire is measured by the foot (meter); and
3. Woven wire is measured by the foot (meter).

The post and wire quantity specified in the contract is an estimate only. The actual quantity required to complete the work will be paid for at the contract unit price.

Panels required for remove and reset fence are not measured for payment.

**607.04.3 Gates**

Gates are measured by the foot (meter) between gate posts.

**607.04.4 Fence Panels**

Single and double fence panels are measured by the unit.

**607.04.5 Deadman**

Deadman are measured by the unit. Anchors are not measured for payment.

**607.04.6 Dozer Operation**

Dozer operation is measured by the hour under Subsection 210.04.1. When dozer operation is not a bid item, it is incidental to and included in other fencing items.

**607.04.7 Remove Fence**

- A. Replaced with New Fence.** When the removed fence is being replaced with new fence, the existing fence removal is not measured for payment.
- B. Without New Fence.** Remove chain link, Interstate, and farm fence is measured by the foot (meter) in place before removal along the top wire, or on a line parallel thereto, exclusive of gates, cattle guards, and other openings to the nearest foot (0.1 m).

**607.04.8 Fence Preparation**

Fence preparation is not measured for payment but is incidental to the fencing items.

**607.05 BASIS OF PAYMENT**

Payment for the completed and accepted quantities is made under the following:

<b><u>Pay Item</u></b>	<b><u>Pay Unit</u></b>
New Fence - Chain Link, Interstate, Farm, Temporary	Foot (meter)
Remove and Reset Fence - Chain Link, Interstate, Farm	Foot (meter)
New Wood or Metal Posts	Each
Barbed Wire	Foot (meter)
Woven Wire	Foot (meter)
Gates	Foot (meter)
Fence Panels	Each
Deadman	Each
Dozer Operation	Hour (see subsection 210.05)
Remove Fence	Foot (meter)

When the removed fence is being replaced with new fence, the cost of removing existing fence is included in the contract unit price per foot (meter) of new fence.

Fence preparation is not paid for but is included in the contract unit price of the fencing items.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.



## **SECTION 608**

### **CONCRETE SIDEWALKS**

#### **608.01 DESCRIPTION**

This work is the construction of concrete sidewalks.

#### **608.02 MATERIALS**

Furnish materials meeting the following Section and Subsection requirements:

Classes "A" and "D" Portland Cement Concrete .....551  
Reinforcing Steel .....711.01  
Joint Materials.....707.01

#### **608.03 CONSTRUCTION REQUIREMENTS**

Construct concrete sidewalks as specified in the contract and as follows.

##### **608.03.1 Subgrade and Forms**

Excavate, shape, and compact the foundation to the specified width and grade.

Place and compact aggregate base to the specified thickness.

Use forms and form meeting Section 552 and Subsection 609.03 requirements.

##### **608.03.2 Concrete**

Furnish and place concrete meeting Section 551 requirements.

Place reinforcing steel as specified.

Dampen the foundation and forms immediately before placing concrete.

Do not place concrete on a frozen foundation course or subgrade.

Construct sidewalks meeting Subsections 501.03.18 and 501.03.19 requirements.

Construct and install truncated domes as shown on the plans and Detailed Drawings. Use red brick color dye in the concrete mix prior to precasting.

#### **608.04 METHOD OF MEASUREMENT**

Concrete sidewalk is measured by the square yard (square meter), including wheelchair ramps.

Truncated domes are measured by the square yard (square meter) to the nearest 0.1 square yard (0.1 square meter).

**A. Contracts with Sidewalk Work Not in Conjunction with Roadway Reconstruction.**

Reinforcing steel, expansion joint material, bond breaker, excavation or embankment, crushed gravel base, and disposal of material associated with the work are not measured for payment.

**B. All Other Contracts.** Reinforcing steel, expansion joint material, bond breaker, disposal of material, and crushed gravel base are not measured for payment. Excavation or embankment associated with the work is measured by the cubic yard (cubic meter).

#### **608.05 BASIS OF PAYMENT**

Payment for the completed and accepted quantities is made under the following:

**Pay Item**

Sidewalk-Concrete

Truncated Domes

**Pay Unit**

Square Yard (square meter)

Square Yard (square meter)

**A. Contracts with Sidewalk Work Not in Conjunction with Roadway Reconstruction.**

The cost of reinforcing steel, expansion joint material, bond breaker, excavation or embankment, crushed gravel base, and disposal of material associated with the work are included in the contract unit price of sidewalk.

**B. All Other Contracts.** The cost of reinforcing steel, expansion joint material, bond breaker, crushed gravel base, and disposal of material associated with the work are included in the contract unit price of sidewalk. Excavation or embankment associated with the work is paid for under the specified type of earthwork.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.

## **SECTION 609**

### **CURBS AND GUTTERS**

#### **609.01 DESCRIPTION**

This work is constructing curbs, integral curb and gutter, median curbs, and furnishing and installing precast concrete curbs.

#### **609.02 MATERIALS**

Furnish materials meeting the following Section and Subsection requirements:

Air-entrained Class "D" Concrete.....	551
Reinforcing Steel .....	711.01
Joint Materials.....	707.01
Yellow Traffic Line Paint .....	714.04
Bituminous Mixtures .....	401

#### **609.03 CONSTRUCTION REQUIREMENTS**

##### **609.03.1 General**

Construct curbs and integral curb and gutter having uniform surfaces and true lines. Remove and replace curb sections that prevent drainage or proper joining of subsequent work at Contractor expense.

Material may be placed adjacent to curbs and curbs and gutters 24 hours after the curbs or curbs and gutters are placed as long as no damage is caused. Correct all damages at Contractors expense.

Construct curbs and integral curb and gutter meeting the contract requirements and as follows.

##### **609.03.2 Foundations and Forms**

Excavate, prepare and compact cast-in-place curb and curb and gutter foundations meeting the moisture and density requirements of Subsection 203.03.3.

Use full depth metal or straight-grained finished lumber forms, free of warp or irregularities, and having the strength to resist springing or deviation from alignment and grade. Securely stake and brace forms with headers and clamps. Clean and oil form surfaces in contact with concrete before placing the concrete.

##### **609.03.3 Cast-in-Place Curb and Gutter**

Moisten the foundations and forms immediately before placing concrete.

Place and consolidate the concrete in uniform layers not exceeding 6-inch (155 mm) loose depth.

Do not place concrete on a frozen foundation course or subgrade.

Construct concrete curb meeting Subsections 501.03.18 and 501.03.19 requirements.

Once the concrete has its initial set, remove the forms and repair honeycombed and rough surfaces using 1:2 mortar. Use wooden floats to remove form marks or other irregularities. Apply a brush finish to the final surface using an approved brush before the concrete sets. Finish all concrete edges, including those at expansion joints, to the required radii.

Water cure concrete or use a curing compound meeting Subsection 551.03.6 requirements. Water cure, keeping the concrete wet for seven days after finishing.

##### **609.03.4 Slip-formed Concrete Curb and Gutter**

Concrete curb and gutter may be constructed using a curb forming or slip-form machine.

**609.03.5 Precast Concrete Curbs**

Furnish precast curb meeting Section 554 requirements and install as specified.

**609.03.6 Bituminous Curbs**

Clean surfaces receiving bituminous curb and prime with SS-1 emulsified asphalt diluted 1:1 with water. Apply approximately 0.2 gallons per square yard (0.91 L per square meter).

Use the project surfacing bitumen mixed with water in a mixer of at least 3 cubic feet (0.08 cubic meters) capacity that meets Section 401 requirements.

The asphalt quantity in the bituminous curb mixture will be established by the Project Manager and will be at least one percent more than that used in the surfacing mixture.

Feed the bituminous mixture to the extrusion or curb machine at a temperature that prevents sloughing or tearing of the material or surface. Pressurize the mixture through an orifice or plate. The machine must heat and compact the curb as it is produced.

Compact all material not placed and compacted by the curb machine using mechanical tampers.

If other than 60-70 penetration asphalt cement is used, apply a fog coat of SS-1 emulsified asphalt diluted 1:1 with water to the finished curb at approximately 0.2 gallons per square yard (0.91 L per square meter).

**609.03.7 Painting Curbs**

Paint curbs, island curbs, and median curbs meeting Subsection 620.03.3(C) requirements.

**609.04 METHOD OF MEASUREMENT**

Curb, integral curb and gutter, and median concrete curb are measured by the foot (meter) to the nearest 0.1-foot (0.1m) along the face of the curb at the flowline.

Reinforcing steel, joint materials, excavation, foundation preparation, and emulsified asphalt for prime coat are not measured for payment.

Paint and painting is measured by the gallon (Liter) under Subsection 620.04.

**609.05 BASIS OF PAYMENT**

Payment for completed and accepted quantities is made under the following:

<b><u>Pay Item</u></b>	<b><u>Pay Unit</u></b>
Curb	Foot (meter)
Integral Curb and Gutter	Foot (meter)
Median Concrete Curb	Foot (meter)
Paint	Gallon (liter)

The cost of reinforcing steel, joint materials, excavation, foundation preparation, and emulsified asphalt are included in the contract unit price of curb.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.

## SECTION 610

### ROADSIDE RE-VEGETATION

#### 610.01 DESCRIPTION

This work is re-establishing vegetative cover on specified areas by topsoiling, seeding, planting, fertilizing, mulching, soil retention blankets, and sodding.

#### 610.02 MATERIALS

Furnish materials meeting the following Subsection requirements:

Water .....	713.01
Topsoil .....	713.05
Seed .....	713.08
Fertilizer .....	713.09
Mulch .....	713.10
Sod .....	713.11
Soil Retention Blankets.....	713.12

#### 610.03 CONSTRUCTION REQUIREMENTS

##### 610.03.1 Topsoiling

Furnish topsoil and pay all royalty, development, smoothing and leveling costs of topsoil removal.

Notify the Project Manager of the proposed topsoil source(s) as soon as possible after the contract award. Topsoil from proposed sources may be used only after sample tests show the material is acceptable.

Complete topsoil areas to the lines, grades, and elevations specified. Do not place topsoil until the designated areas are prepared and all construction work in the area is completed.

Scarify or rip slopes to be topsoiled.

Break up ordinary sod and soil containing grass roots into maximum 2-inch (50 mm) clumps.

Remove and dispose of, at Contractor expense, all clods, rocks, large roots, litter, and other foreign material exceeding 4 inches (100 mm) in its greatest dimension from the topsoil before placing it on the roadway and before final acceptance. Break up the topsoil to an average 4 inches (100 mm) deep.

##### 610.03.2 Seeding, Fertilizing, and Mulching

These requirements apply to establishing vegetation on areas disturbed by the work. Landscaping interchange areas, rest areas, urban areas, and other areas are specified elsewhere in the contract.

**A. General.** Work the areas to be seeded to the specified line and grade before seeding and fertilizing.

Seed all disturbed areas. Permanent seeding of the finished slopes may require multiple seeding. Fertilizing, mulching, permanent erosion control placement, and seeding are specified in the contract.

**B. Seeding Season.** The seeding season is October 15 through May 1. Obtain the Department Agronomist's approval to seed outside this period.

**C. Condition Seedbed Surface.** Condition the seedbed surface area by killing growing weeds, removing or mowing old weedy growth, tilling, discing, harrowing, or scarifying compacted areas, and compacting unstable areas.

Condition all seeding areas unless otherwise directed. The Project Manager may exclude wet, soft or rocky areas from conditioning.

Cultivating, tilling, harrowing, discing, and similar work may, if approved, be performed any time after the contract is awarded.

Break up tight or compacted soils into 2-inch (50 mm) or smaller pieces. Remove or repair discs, harrows, cultipackers, and similar equipment not in good operating condition. Operate discing, harrowing, and soil tilling equipment at right angles to the natural slopes.

Prepare soil using equipment that produces a rough-textured surface ready for seeding and mulching. Operate equipment normal to the natural slopes. The final surface must be 1 inch to 1 1/2 inches (25 mm to 40 mm) below the tops of curbs, catch basins, and other structures.

Rescarify areas to be broadcast seeded within 48 hours before seeding.

#### **D. Seed Distribution.**

**1. General.** Apply seed within 48 hours of the final seedbed conditioning.

Do not broadcast seed or hydraulic seed when weather conditions prevent uniform seed distribution.

Do not cover seed with more than 1/2 inch (13 mm) of soil.

The seed application rate is specified in the contract.

**2. Drill Seeding.** Drill seed slopes 3:1 and flatter using equipment that regulates the seed application rate and planting depth. Acceptable drills are custom seeders, furrow drills, disc drills, or other approved drills. If seed-sowing equipment does not have press wheels, compact the seed using a cultipacker once the ground has been drilled.

Maintain uniform seed distribution in the drill hopper during the work.

Operate all seeding related equipment at right angles to the slope.

Regulate planting depth with depth bands or coulters. Use a drill box partitioned by dividers a maximum 24 inches (610 mm) apart.

Seed rows a maximum 8 inches (205 mm) apart and at right angles to the slope.

**3. Broadcast Seeding.** Hand seeding or mechanical seeding of slopes exceeding a 3:1 slope, narrow medians, or small areas is permissible.

**4. Hydraulic Seeding.** Hydraulic seeding is permissible for slopes steeper than 3:1 or when the seedbed surface is impractical to drill seed.

Perform hydraulic seeding in two operations:

- a. Apply the seed with 1 pound (0.454 kg) of wood or recycled paper mulch per three gallons (11.3 L) of water; and
- b. Apply the remaining mulch, along with fertilizer, if specified. See Subsection 610.03(F)(5).

#### **E. Application of Fertilizer.** When broadcasting seed, apply the fertilizer separately.

When drill seeding, do not apply seed and fertilizer in a single mixture. The fertilizer must be applied separately, either broadcast before seed application, or surface banded during seeding.

#### **F. Mulching.**

**1. General.** Use the mulch type specified in the contract.

Apply mulch to seeded areas within 24 hours after seeding without disturbing the seedbed surface.

Do not apply mulch to ground having free surface water or if wind prevents uniform distribution.

2. **Application of Vegetative Mulch.** Uniformly apply vegetative mulch with a mulch spreader at the specified rate once seeding and fertilizing are completed.

Secure all vegetative mulch to the slopes with a non-asphalt based tackifier containing either plant derived hydrocolloid or polymeric materials. Add the tackifier to the fertilizer/mulch slurry when wood cellulose or recycled paper fibers are used as an over-spray onto the straw/hay mulch.

Tuck vegetative mulch on slopes 3:1 or flatter into the seedbed. Use a mulch tiller for tucking. Operate the equipment perpendicular to the slope.

Use mulch tillers having round, notched blades approximately 1/4-inch (6 mm) thick by 18 inches (460 mm) in diameter spaced 8 inches (205 mm) apart that force the vegetative mulch at least 3 inches (75 mm) into the soil. Equip tillers with disc scrapers.

If temporary erosion controls are needed, straw tucking followed by permanent seeding within the seeding season are acceptable measures.

3. **Applying Fabricated Mulch or Netting.** Place fabricated mulch or netting on the specified or directed areas, securing it to the ground using wire staples, wood pegs, or other approved devices. Apply the mulch or netting over the seeded areas.
4. **Applying Wood Cellulose Fiber or Recycled Paper Mulch.** Apply wood cellulose fiber or recycled paper mulch and fertilizer in one operation with a hydraulic distributor using water as the vehicle. Equip the distributor with a continuous agitator keeping the fertilizer and mulch uniformly suspended throughout the distribution cycle. Adjust the pump pressure to maintain a continuous slurry stream. Size the slurry distribution lines to prevent plugging. Equip the discharge line with hydraulic spray nozzles to uniformly distribute the slurry to the seedbed.

Start mulching at the top of the slope and work downward. Use extension hoses to reach the slope extremities.

5. **Finishing.** Re-mulch areas where mulch is weather damaged.

Repair seedbed and seeding damage caused by displaced mulch material and re-seed the areas before re-mulching. Seedbed repair, re-seeding, and re-mulching required due to the Contractor's negligence is at Contractor expense.

### 610.03.3 Sodding

- A. **Season.** Perform sodding during the normal seeding season or as specified.
- B. **Source of Materials.** Notify the Project Manager of the sod source(s) at least three days before sod cutting begins. Cut and deliver only approved sod to the project.
- C. **Surface Preparation.** Prepare the surfaces to be sodded to the required cross section, grade, and contour. Make the surface smooth and uniform, free of stones, roots, lumps, weeds, and other foreign material. Undercut the prepared surface below the adjacent areas so the top of the new sod is flush with adjacent seedbed or turfed areas and 1 inch (25 mm) below sidewalk and curb tops.

Break the surface up to a fine, granular texture at least 2 inches (50 mm) deep before placing sod.

Fertilize the surface to be sodded a maximum 48 hours before placing sod. Use inorganic fertilizer having minimum active ingredients of 15 pounds of Nitrogen and 40 pounds of  $P_2O_5$  per acre (17 kg of Nitrogen and 44 kg of  $P_2O_5$  per hectare).

- D. **Cutting and Handling Sod.** Machine-cut sod in uniform rectangular sections.

Cut sod to a depth that retains intact, the grasses live dense root system and prevents tearing or breaking of the sod.

Load, unload, and place sod to prevent tearing or breaking of the sod.

- E. Placing Sod.** Lay sod within 36 hours of cutting. Protect sod from dry or cold weather until placed.

Place and fit sod as close as possible staggering the joints between horizontal rows.

Lay the sod strips horizontally on slopes, starting at the slope bottom and work upwards. On slopes steeper than 3:1, anchor the sod with fasteners spaced a maximum 2 feet (610 mm) apart and driven flush with the sod surface.

In waterways, lay the strips parallel to the flow, staggered, and fitted snug and even with the strips already placed.

Fill gaps between sod strips with sod pieces cut to the gap size and shape.

At slope bottoms, extend the sod edges at least 2 inches (50 mm) into the ground or ditch bottom. Turn all other sod area edges into the ground and cover with topsoil, compact and smooth to blend with the adjacent finished grades.

Roller compact the sod with a roller immediately after placement. Provide a smooth, even surface, free from bumps and depressions.

Thoroughly water the sod and re-roll to insure good soil contact.

- F. Sod Maintenance.** Water new sodded areas until the sod is firmly rooted.

Maintain the new sod until it is well rooted and replace all dead, dying, and damaged sod as directed at Contractor expense.

#### **610.03.4 Erosion Control Blanket**

Prepare, fertilize, and seed the erosion control blanket areas before placing the blanket. Handle and place it following the manufacturer's recommendations. If recommendations are not provided, install as follows:

1. In ditches, unroll the blanket downstream and lap 4 inches (105 mm) over the adjoining blanket. Bury the ends and edges to prevent water and wind undercutting.
2. On slopes, the blanket may be unrolled horizontally or vertically to the slope, then lapped 4 inches (105 mm) over the adjoining blanket and stapled as above. Always lap the blanket in the direction of flow.

### **610.04 METHOD OF MEASUREMENT**

#### **610.04.1 Topsoil**

Topsoil is measured by the cubic yard (cubic meter) of loose material level with the haul vehicle box at the point of use on the project. Strike or level loads when directed.

#### **610.04.2 Seeding**

Seeding is measured by the acre (hectare), parallel to the ground surface, to the nearest 0.1 acre (0.1 ha).

#### **610.04.3 Fertilizing**

Fertilizing is measured by the acre (hectare), parallel to the ground surface, to the nearest 0.1 acre (0.1 ha).

#### **610.04.4 Condition Seedbed Surface**

Condition seedbed surface is measured by the acre (hectare), parallel to the ground surface, to the nearest 0.1 acre (0.1 ha).

#### **610.04.5 Mulch**

- A. Vegetative Mulch and Wood Cellulose Fiber Mulch.** Vegetative mulch and wood cellulose fiber mulch is measured by the acre (hectare), parallel to the ground surface, to the nearest 0.1 acre (0.1 ha).



**B. Fabricated Mulch and Netting.** Fabricated mulch and netting is measured by the square yard (square meter) in place.

**C. Bituminous Mulch.** Bituminous mulch is measured by the gallon (Liter) for the gallons (liters) applied at the specified rate.

#### **610.04.6 Sodding**

Sodding is measured by the square yard (square meter) in place, parallel to the ground surface.

Re-sodded areas damaged from causes not the fault of the Contractor are measured for payment.

#### **610.04.7 Soil Retention Blanket**

Soil retention blanket is measured by the square yard (square meter) in place.

#### **610.05 BASIS OF PAYMENT**

Payment for the completed and accepted quantities is made under the following:

<b><u>Pay Item</u></b>	<b><u>Pay Unit</u></b>
Topsoil	Cubic Yard (cubic meter)
Seeding	Acre (hectare)
Fertilizing	Acre (hectare)
Condition Seedbed Surface	Acre (hectare)
Mulch	Acre (hectare)
Fabricated Mulch and Netting	Acre (hectare)
Sodding	Square Yard (square meter)
Soil Retention Blanket	Square Yard (square meter)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of the work under the contract.



## **SECTION 611 CATTLE GUARDS**

### **611.01 DESCRIPTION**

This work is furnishing and installing cattle guards or removing and resetting cattle guards.

### **611.02 MATERIALS**

#### **611.02.1 Concrete**

Furnish air-entrained Class "A" portland cement concrete meeting Section 551 requirements for poured-in-place base concrete.

Furnish Class "D" portland cement concrete meeting Section 551 requirements for precast bases.

#### **611.02.2 Steel**

Furnish reinforcing steel meeting Subsection 711.01 requirements.

Furnish low-alloy weldable steel meeting ASTM A 572 (A 572M), Grade 45 (300 MPa) requirements for crossbars.

Furnish other steel meeting Section 711 requirements.

#### **611.02.3 Paint**

Furnish paint meeting the following Subsection requirements:

Shop (Prime Coat) .....	710.02(B)(7)
Aluminum Paint (Finish Coat) .....	710.02(B)(2)

#### **611.02.4 Cattle Guards**

Furnish standard pre-fabricated cattle guards meeting the following requirements:

- HS 20 (M 518) Live Loading;
- The Detailed Drawings; and
- Subsections 556.03.2 and 556.03.3.

Submit all fabrication drawings for review before fabrication and footing elevations are set.

### **611.03 CONSTRUCTION REQUIREMENTS**

#### **611.03.1 Excavation**

Excavate cattle guard foundations to the specified depth allowing space for formwork.

Complete and compact earth fills meeting Section 203 requirements before excavating for the cattle guard foundation.

#### **611.03.2 Placing Concrete Bases**

Construct poured-in-place concrete bases meeting Section 552 and the Detailed Drawings.

Furnish precast concrete bases meeting Section 554 requirements and the Detailed Drawings.

Construct stringer bearing surfaces to provide full bearing under each stringer. Bushhammer uneven surfaces to provide even bearing.

#### **611.03.3 Placing Cattle Guards**

Fasten the metal structure to the base as specified.

Attach the metal wings to the cattle guard and to the fence as shown in the Detailed Drawings.

All welding must meet the requirements of Subsection 556.03.10.

Backfill and clean up around the completed structure.

**611.03.4 Painting**

Apply one shop coat of primer to all metal parts. Apply a prime coat and a finish coat in the shop or in the field.

Perform all painting meeting the applicable requirements of Section 612.

Re-paint damaged painted surfaces at Contractor expense.

**611.03.5 Resetting Cattle Guards**

Dismantle and reset existing cattle guards at the locations specified in the contract.

**611.04 METHOD OF MEASUREMENT**

New and reset cattle guards are measured by the unit, including the concrete bases, excavation and backfill.

**611.05 BASIS OF PAYMENT**

Payment for the completed and accepted quantities is made under the following:

<b><u>Pay Item</u></b>	<b><u>Pay Unit</u></b>
New Cattle Guard	Each
Reset Cattle Guard	Each

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.

## **SECTION 612**

### **PAINTS AND PAINTING**

#### **612.01 DESCRIPTION**

This work is the surface preparation, furnishing and applying the paint, and protecting the paint coatings, pedestrians, vehicular, or other traffic upon or under the surface being painted.

#### **612.02 MATERIALS**

Furnish materials meeting the applicable requirements of Section 710 and Subsection 612.02.1.

##### **612.02.1 Coating System for Structural Steel**

Furnish a complete coating system consisting of a self-curing zinc-rich primer, an intermediate coat of high-build epoxy paint and a protective top coat of urethane paint meeting Subsection 710.02.3(C) requirements. The epoxy color must be white and the urethane color is specified in the contract.

#### **612.03 CONSTRUCTION REQUIREMENTS**

##### **612.03.1 Coating Systems for Structural Steel**

Submit a written description of the coating system for approval.

Include in the written submittal the manufacturer's product information including but not limited to paint characteristics, surface preparation, film thickness recommendation, safety data, repair procedures and application recommendations.

Bring conflicts between the coating system submittal and the specifications to the Engineer's attention for resolution.

Furnish the services of a paint or painting technical representative from the paint manufacturer at the beginning of paint operations and as required during operations.

Shop-apply the primer. Shop or field-apply the intermediate and top coat. Protect all coats from damage during handling, transporting, and unloading. Repair all paint damage following the coating manufacturers recommendations at Contractor expense.

##### **612.03.2 Protection of Structure, Persons, and Property**

Protect pedestrian, vehicular, and other traffic upon or under the structure, the super-structure and substructure against damage or disfigurement by spatters, splashes, smirches, or over-spray of paint or paint material. Clean and remove all paint damage at Contractor expense.

**A. Pollution Controls.** Prevent environmental pollution including stream and air pollution caused by paint, paint spray, paint chips, dust, or other harmful materials meeting all federal, state, and local regulations and requirements.

##### **612.03.3 Surface Preparation**

Prepare surfaces to be painted following the paint manufacturer's recommendations, or the following, whichever is most restrictive.

**A. Structural Steel for Bridges.** Clean oil and grease from surfaces to be coated before blast cleaning. Solvent-clean oil or grease coated surfaces to meet SSPC-SP 1 requirements.

Surface-clean by the centrifugal wheel or the air blast method. Blast-clean meeting SSPC SP-6, Commercial Blast Cleaning requirements.

Hand-clean the steel bridge bearing components containing PTFE (polytetrafluorethylene), stainless steel surfaces, and neoprene pads to prevent surface damage.

Remove fins, tears, slivers, and burred or sharp edges by grinding and re-clean the area as specified before coating.

Remove blast residue from steel surfaces with clean brushes, compressed air, or a commercial grade vacuum cleaner equipped with a brush-type cleaning tool, or by double blowing. Keep steel dry, dust free and prime steel within 24 hours after cleaning.

Clean structural steel that is not shop painted to meet SSPC SP-7 requirements after erection. Guard angles, pier nose angles, deck expansion joints, and other small structural steel elements may be prepared for painting using wire brushes, scrapers, chisels, or sand blasting as approved.

- B. Galvanized Metal Surfaces.** Treat galvanized metal surfaces to be painted using phosphoric acid solutions of the zinc phosphate and phosphate chromate types formulated for this use. Dry the treated surfaces 20 minutes, then rinse with water. Begin painting within 24 hours.
- C. Previously Painted Surfaces.** Clean to meet SSPC SP-7 requirements.
- D. Steel Not to be Painted.** Steel may be cleaned before or after erection.

#### 612.03.4 Removing Lead Based Paint

- A. Work Plan.** Submit a work plan that meets OSHA and EPA regulations, for lead paint removal work.

Work plans will be reviewed for acceptance within 10 working days of receipt. The Project Manager will notify the Contractor in writing of the work plan acceptance or rejection. Rejected work plans may be re-submitted but must be approved by the Project Manager at least ten working days before beginning any lead paint removal work.

Have the work plan prepared by an individual who has experience with, and worked under, OSHA and EPA regulations. That individual must supervise the work covered by the plan. Include the individual's resume listing qualifications, experience, and references.

Work plans consisting only of copies of specifications and regulations will be rejected. Address the following items in the written work plan:

- 1. Worker Protection.** Meet the OSHA lead standards of Title 29, CFR 1926.62. Describe medical surveillance, exposure monitoring, respiratory protection, personal hygiene, employee training, employee access to records, hazard communication and a compliance program to reduce lead exposure to within the Permissible Exposure Limits (PELs). Exposure monitoring must meet NIOSH Method 7082.

Provide the Engineer copies of pulmonary capacity tests, copies of employee training certificates, and the blood test results from all workers involved in the paint removal. Take one test before beginning work, then every four weeks thereafter until the work is complete. The Engineer may adjust the frequency based on the tests results. Take the final blood test within two weeks of completing the paint removal.
- 2. Environmental Protection.** Design a containment system meeting SSPC 1,2 or 3 "Guide for Containing Debris Generated During Paint Removal" requirements except that permeable wall materials cannot be used. The containment system may be located on or off the project site. Submit shop drawings and design calculations for containment systems attached to the structure. Include design calculations that address all load conditions on the structure resulting from the containment system including debris.

Specify ventilation and negative pressure equipment capacity, layout, and related calculations.

- B. Air Quality.** Test and monitor air quality for particulate and lead matter under Part 40 CFR 50. Sample air quality before construction for background particulate matter. Monitor air quality during construction until four consecutive samples show emissions not exceeding 400 µg per cubic meter of PM10 over an 8-hour period. If emissions exceed 400µg per cubic meter, stop work until the containment system is corrected to meet the required air quality level. Use high volume monitors placed upwind for background levels and downwind of the work and near the right of way line for monitoring emissions.

Sample air quality for lead before and during construction. Test background levels before construction by placing the monitor upwind of the project.

Take four consecutive samples when construction starts from monitors placed downwind and near the right of way line to determine emission levels. The maximum allowable emission in an 8-hour period is calculated by the following formula:

$$AE = 90/PD \times 1.5 \mu\text{g}/\text{m}^3 \times 3$$

Where:

AE = 8-hour allowable emission in µg/m<sup>3</sup>

PD = project duration in days

The maximum and minimum value for PD is 90 and 30 respectively.

Stop work when samples exceed the allowable AE until the containment system is corrected and emissions fall within the acceptable limits.

- C. Soil Quality.** Do not contaminate the soil with lead. The Department will take soil samples before and after construction for contamination testing. The Contractor is responsible for all work and costs to restore the soil to the condition represented by the pre-construction sample.
- D. Water Quality.** Do not contaminate any water system with lead debris (spent abrasive, paint chips, etc). The Department will take sediment samples below and downstream of the project before and after work begins for contamination testing. The Contractor is responsible for all work and cost to restore the water system to the condition represented by the pre-construction sample.
- E. Disposal.** Contain and store the material meeting the approved plan. The Department is responsible for disposal.

#### 612.03.5 Application of Paint

- A. General.** Do not paint when weather conditions would cause unsatisfactory work. Follow the paint manufacturer's recommendations for surface temperature and dewpoint/temperature requirements. The Project Manager may stop painting at any time if current or impending weather conditions could cause unsatisfactory coating performance.

Correct failures or damage to new painted surfaces at Contractor expense. Provide a minimum dry film thickness of 1.5 and 1.0 mils (35 µm and 25 µm) respectively for each primer and succeeding field coat of paint over metal unless the paint manufacturer recommends otherwise.

Provide the Inspectors ready and safe access to the work at all times. The Project Manager will suspend work for unsafe or inadequate access facilities. Assure all fabrication inspections are complete before beginning painting.

**B. Painting Structural Steel.**

- 1. Application.** Apply three coats of paint to new structural steel specified to be painted. This includes but is not limited to steel and metal structures such as bridge rail, sign posts, and sign structures exposed to the weather. Paint in a neat and workmanlike manner.

Follow the paint manufacture's recommendation when brush or spray painting to produce a uniform, even coat to the metal or previous paint coat. Brush paint thoroughly coating the surface irregularities and brush out and smooth to produce an even paint film thickness. Equip spray pressure tanks with an agitator that thoroughly stirs the paint.

Stir the paint as recommended by the manufacturer before removing it from the containers and during application. The Project Manager may approve hand mixing when each coat of paint is 5 gallons (20 L) or less.

Follow the manufacturer's recommendations for paint thinning.

Paint surfaces inaccessible to paint brushes with sprayers or daubers made for that use.

Protect painted surfaces from adverse weather until the paint has dried or weather permits removing the cover.

Remove and replace unsatisfactory paintwork at Contractor expense.

- 2. Shop Paint.** Apply one coat of zinc rich primer to all steel surfaces specified to be painted, except surfaces in contact after erection. Apply the shop coat immediately after the fabrication, shop inspection, and shop cleaning are complete and the work has been accepted.

Do not paint metal surfaces that are in contact with other items after erection except as specified in Subsection 612.03.5(C)(1). Do not pack or ship materials until the paint is dry. Field coats may be applied in the fabrication shop only if approved in writing by the Engineer.

Make erection marks for the field identification of members on painted surfaces. Assure erection marks, fabricator's name, or other identification does not show through the final coat of paint. Use marking paint that is compatible with the shop coat and first field coat.

Shop coat machined-finished surfaces, excluding abutting chord splices, column splices, and column and truss shoe bases as soon as practical after acceptance with a zinc-rich primer coat. Machine finished iron and steel casting surfaces to remove scales, scabs, fins, blisters, and other surface deformations must be painted with a zinc-rich primer.

- 3. Field Cleaning.** Remove all rust, scale, dirt, grease, unacceptable shop paint and other foreign material following the paint manufacturers recommendations when erection work is complete.

- 4. Field Painting.**

- a. Application Conditions.** Apply paint following the manufacturers recommendations for temperature (air, surface, material), relative humidity and substrate temperature or as follows, whichever is more restrictive.

Do not apply paint when the ambient temperature is 40 °F (5 °C) or is expected to drop below 40 °F (5 °C) within 2 hours of application.

Do not apply paint when rain, snow, or condensation is expected within two hours after application at the painting location. The Project Manager may stop paint operations when impending weather could harm freshly applied paint. Do



not apply paint when the relative humidity is greater than 85 percent or when temperature and humidity cause condensation on the surface to be painted.

Do not apply paint to metal with surface temperatures that exceed 110 °F (40 °C) or when the surface temperature causes the paint to blister or produce a porous paint film.

- b. Accessory Preparations and Spot Painting.** Thoroughly clean masonry and sole plates, the outside faces of end floor beams, the bottom of expansion devices, and all parts of steel work inaccessible for painting after erection of all foreign material. Spot coat and apply two field coats. Perform the painting on site and allow it to thoroughly dry before assembling. Handle painted material to prevent paint damage. Repair and repaint damaged surfaces at Contractor expense.

Apply only the primer shop coat to the exposed surfaces of bridge deck and approach slab guard angles, expansion devices, and armored joints embedded in the roadway surface. Apply two coats of field paint to the entire curb or sidewalk portion of these members as specified elsewhere in this Section.

After erection and field cleaning is approved, apply the spot coat to the edges of the plates, rolled shapes and angles, to the heads of all field rivets, pins, nuts and areas where the shop coat has been damaged. The Project Manager may require a complete shop coat reconditioning or replacement on damaged surfaces at Contractor expense.

Re-seal small cracks and cavities left by the first coat with a zinc paste before applying the second field coat.

- c. Field Coating.** Once the field cleaning is complete and the spot coat is thoroughly dried, apply one field coat of epoxy paint to all metal and the finish coat of urethane paint. Do not apply the urethane until the epoxy has dried as recommended by the paint manufacturer.
- d. Painting Season.** Field painting season for structural steel, metal posts or poles, and bridge rail is from May 1 to October 31, unless otherwise approved in writing by the Project Manager.

#### **C. Painting Bridge Rail.**

- 1. Metal Bridge Rail.** Prepare metal bridge rail to be painted meeting the applicable requirements of Subsection 612.03.3.

Apply the spot coat and the first and second field coats before erection and fit-up to the following contact surfaces:

- a.** Rail to post contact surfaces;
- b.** Bridge rail expansion sleeves; and
- c.** Bridge rail post base plates.

Apply the first and second coat to the rest of the rail after erection, fit-up, and final adjustment of the rail to line and grade.

Repair coating damage to galvanized members with an approved zinc-rich paint.

- 2. Wood Rail and Posts.** Primer and paint for wood rail and posts are specified in the contract. Apply paint meeting the applicable requirements of Subsection 612.03.05.

### **612.04 METHOD OF MEASUREMENT**

Paints and painting is not measured separately but is incidental to the items being painted.

**612.05 BASIS OF PAYMENT**

Paints and painting is not paid for separately but is included in the cost of the item painted and includes all materials and resources necessary to complete the work.

## SECTION 613

### RIPRAP AND SLOPE AND BANK PROTECTION

#### 613.01 DESCRIPTION

This work is the construction of protective rock, stones, gravel, or concrete coverings as specified.

Riprap is a cover of stone or fragmented rock, with or without grout, placed along embankment slopes, stream banks, culvert inlets and outlets, foundations, bridge berms, dikes, and other specified locations.

Bank protection is a cover of rock or coarse gravel placed on the side slopes of structure channels and other specified locations.

Concrete slope protection is a cover of portland cement concrete placed on slopes at structure ends.

#### 613.02 MATERIALS

Furnish materials meeting the following Section and Subsection requirements:

Handlaid, Random, and Grouted Riprap.....	701.06
Cement Grout .....	713.04
Bedding Material .....	701.04.1
Bank Protection .....	701.07
Class "D" Portland Cement Concrete .....	551
Sand-gravel Cushion .....	701.08

#### 613.03 CONSTRUCTION REQUIREMENTS

##### 613.03.1 Riprap

**A. General.** Place the riprap at the locations specified in the contract.

Key the riprap ends into the embankment slopes at least 2 feet (610 mm) from the outer face of the riprap for the full height of the riprap.

**B. Handlaid Riprap.** Bed the stones at right angles to the slope with the larger stones used in the lower courses. Lay the stones in close contact with staggered vertical joints and placed so each stone rests on the embankment slope instead of the underlying stones. Fill the spaces between the stones with smaller stones or rock, securely placed.

Finish the work to present an even, tight plane varying no more than 3 inches (75 mm) from the general contour of the revetment.

Provide a minimum riprap thickness of 12 inches (305 mm), measured perpendicular to the slope, or as specified.

**C. Random Riprap.** Place the stones on the slopes to form the specified cross section. Uniformly distribute the smaller stones throughout the work. Manipulate the stones by hand or machine to provide a uniform surface and stable mass.

Provide the riprap thickness specified on the plans.

Place the riprap around pipe openings without damaging the pipe. Repair damaged pipe at Contractor expense.

**D. Grouted Riprap.** Provide a minimum riprap thickness of 9 inches (230 mm) measured perpendicular to the slope, or as specified.

Place one or more layers of bedding material before placing the riprap as specified. Place each bedding layer on the prepared surface to the specified thickness in one

**BANK PROTECTION**

operation without segregating the layer. Finish the top layer to produce an even surface free from mounds or ridges. Do not inter-mix the materials of each layer.

Fill the voids between stones with spalls or small stones so all stones are wedged or keyed. Prevent earth and sand from filling the spaces between the stones.

Finish the final surface to provide an even, tight surface with the plane not varying more than 3 inches (75 mm) from the general contour.

Wet the riprap surface and fill the crevices and openings with at least 3-inches (75 mm) of mortar. Immediately sweep the surface with a stiff broom.

Grouting may begin when the ambient temperature is at least 35 °F (2 °C) and rising and must stop when the ambient temperature is 30 °F (-1 °C) and falling.

Keep finished grout work moist for three days.

**613.03.2 Bank Protection**

Bank protection may be hand-placed or machine placed and leveled. Construct the finished bank protection to be stable with no voids larger than the smallest stone used in the work.

Use rock spalls or gravel to fill the voids. Not more than five percent of the total bank protection volume may be earth, sand, or rock material smaller than 3/16-inch (5 mm) for filling voids.

Bed the bank protection as shown in the contract.

**613.03.3 Concrete Slope Protection**

Trench, shape, compact, and trim the slopes as specified before starting concrete work. Excess excavated material may be used elsewhere in the work or disposed of by the Contractor.

Construct the concrete slope protection as specified or directed.

**613.03.4 Concrete Drainage Chute**

Construct concrete drainage chutes as shown in the Detailed Drawings.

**613.04 METHOD OF MEASUREMENT****613.04.1 Riprap**

**A. Handlaid and Random Riprap.** Handlaid and random riprap is measured by the cubic yard (cubic meter) to the nearest cubic yard (cubic meter) complete in place. The volume measured for payment is that bounded by the staked length and height and the plan thickness.

Excavation is incidental to the riprap and not measured for payment.

**B. Grouted Riprap.** Grouted riprap is measured by the square yard (square meter) to the nearest square yard (square meter) on the face of the revetment.

Excavation is incidental to the riprap and not measured for payment.

Bedding material is measured by the cubic yard (cubic meter) to the nearest cubic yard (cubic meter).

**613.04.2 Bank Protection**

Bank protection is measured by the cubic yard (cubic meter) to the nearest cubic yard (cubic meter) complete in place. The volume measured for payment is that bounded by the staked length and height and the plan thickness.

Excavation and bedding material are not measured for payment.

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**613.04.3 Concrete Slope Protection**

Concrete slope protection is measured by the square yard (square meter) to the nearest 0.1 square yard (0.1 square meter). Measurement is made parallel to the surface of the exposed surface area including the surfaces of curbs and head walls.

Excavation is incidental to the item and not measured for payment.

Sand-gravel cushion is measured by the cubic yard (cubic meter) compacted in place.

**613.04.4 Concrete Drainage Chute**

Concrete drainage chutes are measured by the cubic yard (cubic meter) and include the excavation, concrete placement, and bank protection at the chute ends.

**613.05 BASIS OF PAYMENT**

Payment for the completed and accepted quantities is made under the following:

**Pay Item**

Handlaid and Random Riprap  
Grouted Riprap  
Bank Protection  
Concrete Slope Protection  
Bedding Material  
Sand-gravel Cushion  
Concrete Drainage Chute

**Pay Unit**

Cubic Yard (cubic meter)  
Square Yard (square meter)  
Cubic Yard (cubic meter)  
Square Yard (square meter)  
Cubic Yard (cubic meter)  
Cubic Yard (cubic meter)  
Cubic Yard (cubic meter)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.



## **SECTION 614**

### **RETAINING WALLS**

#### **614.01 DESCRIPTION**

This work is constructing concrete and metal bin-type retaining walls.

#### **614.02 MATERIALS**

Furnish materials meeting the following Section and Subsection requirements:

Concrete .....	551
Reinforcing Steel .....	711.01
Metal Bin-Type Retaining Walls.....	711.21
Backfill For Metal Bin-Type Retaining Walls.....	701.09

#### **614.03 CONSTRUCTION REQUIREMENTS**

##### **614.03.1 Foundations**

Excavate and prepare foundations for concrete retaining walls meeting the applicable requirements of Subsection 209.03.

Construct metal bin-type retaining wall foundations to the established lines and grades and compact meeting Subsection 203.03.3 requirements.

The Project Manager will inspect and approve all foundations before subsequent work.

##### **614.03.2 Concrete Retaining Walls**

Construct concrete retaining walls as specified in the contract. Perform concrete work meeting the applicable requirements of Section 552.

Remove all deleterious material from the footings before placing concrete. Prepare the footing surface meeting the requirements for bonding construction joints in Subsection 552.03.7. Make vertical construction joints as specified in Subsection 552.03.7.

##### **614.03.3 Bin-type Retaining Walls**

Assemble the wall parts following the wall manufacturer's recommendations.

If approved, the wall height and depth may be varied but can not exceed the maximum dimension shown.

Two or more retaining wall designs may be used in the same wall, using standard split columns to make the stepback connection.

##### **614.03.4 Backfill**

**A. Concrete Structures.** Furnish the backfill material specified in the contract. Place backfill as specified in Subsection 203.03.2(B).

**B. Metal Bin-type Retaining Walls.** Follow the manufacturer's recommendations for placing and compacting backfill material. If no recommendations are made, bring the backfill up equally inside and outside the bins as follows:

- For backfill material outside the bins, use roadway excavation and place it as specified in Subsection 203.03.2(B).
- Furnish backfill material for inside the bins meeting Subsection 701.09 requirements.
- Place the backfill in 8-inch (205 mm) maximum compacted lifts, completely filling in all corrugations. Compact backfill as specified in Subsection 203.03.3. Hollow sounding corrugations in the bin wall face detected by the Inspector is cause to remove, replace, and re-compact the backfill at Contractor expense.

**614.04 METHOD OF MEASUREMENT****614.04.1 Concrete**

Concrete is measured by the cubic yard (cubic meter) under Subsection 552.04.

**614.04.2 Reinforcing Steel**

Reinforcing steel is measured by the pound (kilogram) under Subsection 555.04.

**614.04.3 Metal Retaining Walls**

Metal bin-type retaining walls are measured by the nominal square foot (square meter) of facial area of wall.

**614.05 BASIS OF PAYMENT**

Payment for the completed and accepted quantities is made as follows:

**Pay Item**

Concrete

Reinforcing Steel

Metal Retaining Wall

**Pay Unit**

Cubic Yard (cubic meter)

Pound (kilogram)

Square Foot (square meter)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.



**SECTION 615**  
**IRRIGATION FACILITIES**  
**AND HEADWALLS**

**615.01 DESCRIPTION**

Irrigation facilities and headwalls is furnishing and constructing irrigation structures meeting these specifications and the contract requirements.

**615.02 MATERIALS**

Furnish material meeting the contract and the following Section requirements:

Concrete, Class "DD" .....551

**615.03 CONSTRUCTION REQUIREMENTS**

Construct irrigation facilities and headwalls meeting the contract requirements and the following.

Excavate meeting the applicable Section 209 requirements. Construct and install concrete structures meeting the applicable Section 552 requirements. Place reinforcing steel as shown in the contract. Moisten all surfaces where concrete is to be placed before the concrete is placed.

**615.04 METHOD OF MEASUREMENT**

Concrete is measured under Subsection 552.04. Reinforcing steel and excavation are incidental to concrete and not measured for payment.

**615.05 BASIS OF PAYMENT**

Payment for the completed and accepted quantities is made under the following:

**Pay Item**

Concrete

**Pay Unit**

See Subsection 552.05

Payment at the contract unit price is full compensation for all necessary resources to complete the item of work under the contract.



## **SECTION 616**

### **CONDUITS AND PULL BOXES**

#### **616.01 DESCRIPTION**

This work is furnishing and installing plastic and steel electrical conduit, including fittings, junction boxes, pull boxes, and accessories.

#### **616.02 MATERIALS**

Furnish materials meeting the following Subsection requirements:

Conduit .....	703.02
Pull Boxes .....	703.03

#### **616.03 CONSTRUCTION REQUIREMENTS**

##### **616.03.1 General**

Install conduit and pull boxes meeting the National Electric Code (NEC) requirements.

Conduit lengths in the contract are estimated, and may require changes, approved by the Project Manager, to avoid underground obstructions. Refer to Subsection 107.18 regarding locating of underground utilities before excavation.

Provide the specified conduit size, or substitute a larger size conduit at Contractor expense. Do not change conduit size within any conduit run. Use minimum 2-inch (53 mm) diameter conduit between pull boxes and adjacent standard bases.

Install pull boxes and conduits as specified with the pull box covers flush with the concrete facing or as directed.

Compact backfill material for conduit trenches constructed outside of the roadbed sections to the density of the adjacent material.

Restore existing surfaces disturbed by conduit or pull box installations to the original type and condition.

##### **616.03.2 Plastic Conduit**

Excavate trenches for plastic conduit a minimum 24 inches (610 mm) deep. Tamp the trench bottom and bed with 2 inches (50 mm) of sand before laying the conduit. Once the conduit is placed, place and compact sand, or soil free of rocks or hard lumps, 6 inches (155 mm) above the pipe. Complete the backfill using material passing a minus 3-inch (75 mm) screen.

Join conduit using a solvent-welded slip-fitter coupling to provide a watertight joint.

Separate plastic parallel and perpendicular conduit runs from each other with at least 3 inches (75 mm) of sand or soil cushion. Cap open ends of conduit to prevent moisture, dirt, or rocks from entering the conduit.

Terminate plastic conduit runs at least 9 inches (230 mm) from the pullbox or foundation with a plastic threaded adaptor. Thread a rigid steel conduit bend into the adaptor for the pullbox or foundation entry. Use insulated bushings and electrically bond the steel conduit ends.

For plastic conduit runs 300 feet (91 m) or longer, leave one end disconnected or insert an "O" ring expansion coupling near one end of the run.

##### **616.03.3 Steel Conduit**

Install rigid conduit meeting the National Electrical Code Article 346.

Use the size and type of conduits and fittings specified in the contract.

Make field cuts square and true so that the ends join full circumference. Ream the conduit ends to remove burrs and rough edges.

Slip joints or running threads are not permitted for coupling conduit. Use an approved threaded union coupling when a standard coupling cannot be used.

Coat any new threads on conduit with a cold galvanizing compound before making couplings.

Tighten couplings until the conduit ends are brought together making a good electrical connection throughout the entire conduit run.

Paint damaged conduit coating with a cold galvanizing compound.

Thread and cap conduit with standard pipe caps until the wiring is placed. Install insulated grounding bushings when caps are removed.

Terminate conduit in standard or pedestal foundations at least 3 inches (75 mm) from the foundation top. Keep conduit within foundations at least 6 inches (155 mm) from the foundation face.

Have conduit enter the foundation at least 24 inches (610 mm) from the top. Conduit stubs on structures are specified in the contract. Paint conduit stubs, caps, and exposed threads with rust-preventative paint.

Mark the conduit end locations in structures and at curbs directly above the conduit end by cutting a minimum 3-inch (75 mm) "Y" into the curb face, gutter, or wall.

Make conduit field bends having a minimum radius of six times the inside diameter of the conduit. Factory conduit bends must not crimp or flatten the conduit and use the longest practical radius.

Place and securely hold in position conduit ends, anchor bolts, and other fittings set in concrete until the concrete sets.

Lay conduit a minimum of 18 inches (460 mm) below the curb grade in sidewalk areas and not less than 24 inches (610 mm) below the finished grade in all other areas.

Install conduits under railroad tracks to railroad company requirements. Notify the Department and the railroad company at least 48 hours before starting work on railroad property.

Place conduits installed under an existing roadway as specified.

Jack or drill conduits without damaging the roadway surface.

Open cut highways only if other methods have failed and if approved by the Project Manager. The Project Manager may approve cutting small test holes in the roadway surface to locate obstructions. Keep jacking and drilling pits at least 2 feet (610 mm) away from the roadway surface edge. Do not undermine the roadway surface or soften subgrade when using water.

When approved by the Project Manager, trench across paved roadways without disturbing or injuring the paved surface on both sides of the trench.

Cut asphalt pavements leaving a straight cut face. Excavate, install conduit, and backfill with approved material. Fill the top 1 foot (305 mm) of the trench with compacted plant mix or as directed. Replace all damaged pavement.

Compact backfill material in the roadbed section to at least 95 percent of maximum density at optimum moisture content meeting Subsection 203.03.3 requirements.

Extend conduit terminating in standards or pedestals above the foundation and slope it towards the handhole opening. Terminate conduit entering concrete pull boxes 2 inches (50 mm) inside the box wall, at least 2 inches (50 mm) above the bottom, and slope it to aide cable pulling. Locate conduit entrances in pull box bottoms near the end walls leaving most of the box clear. Install conduit outlets in the box from the direction of the run. Seal conduit leading into socket walls, lights, or fixtures below the pull box grade using a watertight sealing compound.

Install a pull wire in all unused conduits over 10 feet (3 m) long. Double at least 2 feet (610 mm) of pull wire back into the conduit at each termination point for runs over 100 feet (30.5 m); double 1 foot (305 mm) back for shorter runs.

Install a conduit expansion joint, detailed in the contract, where the conduit crosses a fixed or structure expansion joint. Equip each expansion fitting with a grounding strap jumper. Thoroughly clean contact areas before clamping grounding straps.

Secure all conduit bonds, lighting bracket anchor bolts, and bridge rail anchor bolts to form a continuous mechanical and electrical system.

Clean out existing underground conduit incorporated into new conduit with compressed air and mandrel for size if required.

#### **616.03.4 Pull Boxes and Manholes**

Construct and install pull boxes and manholes as specified. The Contractor may install additional pull boxes to aide the work at its expense. Install pull boxes and manholes with covers level with curbs, sidewalks, and surrounding ground. Bed the box bottoms in concrete or crushed rock as specified.

### **616.04 METHOD OF MEASUREMENT**

#### **616.04.1 Lump Sum Basis**

When a conduit system or portion thereof is specified in the contract on a lump sum basis, the system is measured by the lump sum.

#### **616.04.2 Conduit**

Conduit is measured by the foot (meter) to the nearest 1 foot (0.1 m).

#### **616.04.3 Pull Boxes and Manholes**

Pull boxes and manholes are measured by the unit.

### **616.05 BASIS OF PAYMENT**

Payment for the completed and accepted quantities is made under the following:

<b><u>Pay Item</u></b>	<b><u>Pay Unit</u></b>
Conduit System	Lump Sum
Conduit	Foot (meter)
Pull Box	Each
Manhole	Each

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.



## **SECTION 617**

### **TRAFFIC SIGNALS AND LIGHTING**

#### **617.01 DESCRIPTION**

This work is installing or modifying of traffic signal(s), lighting, and other electrical systems.

#### **617.02 MATERIALS**

Furnish materials meeting the following Section requirements:

Lighting and Signal Materials.....	703
Paints.....	710
Class "D" Portland Cement Concrete .....	551

#### **617.03 CONSTRUCTION REQUIREMENTS**

##### **617.03.1 General**

Obtain daily, safety circuit clearance from the servicing utility before starting work on existing series street lighting circuits. Pull cut-out plugs and place worker signs at cut-out boxes before work is started.

Pick up State-furnished material and equipment from the Department of Transportation, Traffic Engineering Section, 2701 Prospect Avenue, Helena, Montana, and transport to the project as part of the contract unit price. Provide the Traffic Engineering Section at least 48 hours advance notice before arriving to take delivery.

Repair or replace all existing improvements and equipment disturbed, damaged, or removed in performing the work at Contractor expense.

The locations in the contract for signal and light standards, controller pedestals, conduit runs, pull boxes, illuminated signs, and appurtenances are approximate. The Project Manager will establish the exact field locations.

Furnish and install all incidental parts not specified but necessary to complete or modify the traffic signal, lighting, or other electrical systems at Contractor expense.

Make arrangements with the serving utility for providing service to the project.

Pay all fees and energy costs up to the time the project is accepted. The Department will pay for the energy costs to operate signals and lighting for public benefit, when ordered by the Project Manager.

All systems must be complete and operable when the work is completed.

See Section 703 for additional construction requirements.

##### **617.03.2 Equipment Lists and Drawings**

Submit the following to the Electrical Section of the Traffic and Safety Bureau for approval after award:

1. A complete list of the proposed equipment and material. Include the quantity, description, size, name of the manufacturer, and catalog number of each item. Indicate which items are on the Department's Qualified Products List (QPL).
2. Manufacturer's catalog sheets for each item of equipment and material listed that are not on the Department's QPL. The catalog sheets must have the specific items to be used underlined in red include item specifications.
3. Shop drawings, design calculations, and welding procedures for all metal signal and luminaire standards that are not on the Department's QPL. Check and approve the shop

drawings and design calculations before submitting, and show the Contractor's approval on the drawings.

4. Documentation required by the QPL for items that are on the approved QPL list.
5. Certified mill test report's for pole material and the manufacturer's certification that pole material and galvanizing meets specifications.

Materials and equipment listed as approved on the QPL at the time that the list of proposed equipment and materials is submitted, may be accepted as a pre-approved QPL item in lieu of the normal submittal and approval process outlined in this section.

Obtain further information and requirements on the QPL website, located at <http://www.mdt.mt.gov> contracting/consultant link.

The Department has 15 Working Days after receipt to approve the submittals. Upon receipt of the approved list of equipment and material, immediately order the materials and submit copies of the dated purchase orders for major items. Re-submit any disapproved items for Department review within 20 working days of notification of disapproval.

Submit copies of the invoices showing the shipping dates within 10 calendar days of the invoice dates.

The calendar date or the number of working days allowed for completion of the contract will be adjusted by the number of days the Department's review of submittal's overrun the Department's review time, if the Departments delay affects the Contractors operation as shown on the current work schedule.

The Department is not liable for any material purchased, labor performed, or work delay (except as stated above) before approval of the required submittals.

All material is subject to inspection after delivery to the project and during installation on the project. Failure by the Project Manager to note defective material or faulty workmanship during construction does not relieve the Contractor of responsibility for removing or replacing defective material or redoing work at Contractor expense. Inspection or sampling of certain materials may be made at the factory or warehouse before delivery to the site at the Project Manager's discretion. No material rejected before delivery, is to be delivered to the project, and all material rejected on the project must be removed from the work.

Submit all equipment guaranties and warranties.

Comply with the requirements of Subsection 106.09.

### **617.03.3 Maintenance of Signals**

Maintain existing traffic signals that are moved or modified once work begins.

The responsibility for existing traffic signals continues with the agency normally responsible for the traffic signals until work begins.

Be responsible for new or modified traffic signals placed in service until the project is accepted. Provide in writing the names and phone numbers of the persons responsible for the operability and maintenance to the jurisdictional law enforcement agency and the Project Manager in case of signal malfunction.

### **617.03.4 Excavating and Backfilling**

Excavate for conduit, foundations, other equipment and materials as specified. Excavate trenches to the width necessary to install electrical equipment, materials, and foundations. Saw cut all existing pavements before excavating.

Do not start excavation until the conduit, equipment, and materials are on site.

Place excavated material without obstructing vehicular or pedestrian traffic or surface drainage. Remove and dispose of surplus excavated material at the end of each workday.



Backfill excavations meeting Subsection 209.03.6 requirements. Bring excavations up level with the adjacent surface or grade to drain as required until permanent repairs are made.

When construction is suspended each day, clear all equipment and material from the roadway for public use as specified in Section 618.

Restore sidewalks, pavement, and landscaping at each intersection before starting work at other intersections. Restrict only one traffic lane for excavations in streets and highways at any time, following the approved traffic control plan.

#### **617.03.5 Removing and Replacing Improvements**

Replace or re-construct existing sidewalks, curbs, gutters, pavement, bituminous surfacing, base material, and other improvements removed, broken, or damaged by the Contractor with equal or better quality materials.

Cut concrete sidewalk and pavement borders to be removed without damaging the adjacent surface. Whenever a part of the existing concrete sidewalk, driveway or pavement is broken or damaged, remove the entire square or slab and replace the concrete as specified.

Repair or remove and replace all existing improvements damaged by the Contractor at its expense.

#### **617.03.6 Foundations**

Construct post, standard, controller cabinet, and pull box concrete encasing pad foundations using Class "D" portland cement concrete meeting the applicable requirements of Section 551.

Place the concrete foundation bottoms on undisturbed ground. Mono-lithically pour foundations where practical. Form the exposed faces. Assure forms are rigid and braced true to line and grade. Finish the footing tops for posts and standards, except special foundations, to the curb or sidewalk grade or as directed. Position and hold in place conduit ends and anchor bolts using a template until the concrete has set.

Install luminaire and Type 1 signal foundations to ensure that no portion of the foundation or base that is non-breakaway projects more than 4 inches (100 mm) above the ground line.

Apply an ordinary surface finish to the exposed concrete surfaces meeting Subsection 552.03.12.

Where obstructions prevent the construction of planned foundations, the Contractor may propose an alternate foundation construction method.

Posts, poles, standards, and pedestals may be erected, plumbed and raked after the foundation concrete has cured at least 72 hours.

#### **617.03.7 Conductors and Wiring**

Install wiring meeting the National Electric Code requirements.

Neatly arrange and lace wiring in cabinets, junction boxes, and the like.

Run conductors in conduit except inside poles. Remove all dirt and moisture from the conduit runs before pulling wiring. Use powdered soapstone, talc, or other approved lubricant when placing conductors in conduit.

Run signal light conductors without splices from a terminal block located in the cabinet, compartment, or signal head to a similarly located terminal block.

Splice conductors only where specified using approved watertight connectors. Locate connectors in pole bases to be easily accessible through the handhole.

Leave at least 2 feet (610 mm) of slack for each conductor at each standard and pull box.

Use a conductor separate from the signal light circuit for all 24-volt circuits, such as pedestrian push-button circuits.

When conductors and cables are pulled through conduit, tape the conductor and cable ends to seal out moisture until the splices are made or terminal appliances attached. Tape the ends of spare conductors.

Tag cables at controller cabinets and poles to show routing. Provide color-coded wire diagrams for individual wire routing.

#### **617.03.8 Span Wire-mounted Signals**

Install span wire suspended signals on overhead guys providing a sag of five percent of the total span distance.

Raise overhead guys with the signals attached, to the specified sag. Adjust the guy mounting height at either or both poles, or the sag, or the rake of steel poles so that the signals are at the specified height with the proper sag and the poles are plumb when completed. Do not pull guys beyond the specified sag.

#### **617.03.9 Bonding and Grounding**

Make metallic cable sheaths, conduit, and metal poles and pedestals mechanically and electrically secure to form a continuous grounded system. Use copper wire or strap of equal cross sectional area to an AWG No. 6 conductor for bonding and grounding jumpers. Use a No. 6 copper bonding strap, to bond standards and pedestals, attaching it to an anchor bolt and all conduit. Use a bare copper AWG No. 6 solid wire connected between the grounding lug on the standard or pedestal and the bonding strap. Ground one side of the secondary circuit of series-multiple transformers.

Ground conduit and neutrals at service points meeting the Electrical Code or this Section, except use AWG No. 6 conductor or equal for grounding.

Furnish and install nonferrous ground rods or approved equals of at least 5/8 inch x 8 feet (16 mm x 2.4 m) at each service point. Install ground rods meeting the contract and Code requirements. Bond the service equipment to the ground rod using a ground clamp and a bare AWG metal No. 6 solid copper wire or equal enclosed in a 3/4-inch (21 mm) diameter schedule 80 plastic conduit.

#### **617.03.10 Service Connections**

Service pole locations shown in the contract are approximate. The Contractor, Project Manager and serving utility will jointly determine the exact locations. The utility must specify the riser location when the Contractor is to install the lower section of a riser on a utility pole.

#### **617.03.11 Conduit and Pull Boxes**

Refer to Section 616.

#### **617.03.12 Painting**

Perform painting meeting Section 612 requirements.

Clean standards, frames, signal bridges, fittings, and other metal parts to be painted following the paint manufacturer's recommendations before applying paint.

Apply two coats of cold galvanizing compound to breaks, abrasions, and damaged galvanized surfaces. Undamaged, shop-coated metal parts do not require field priming.

Prepare galvanized surfaces to be painted following the paint manufacturer's recommendations or as follows if no recommendations are made:

- Dissolve 2 ounces (59 mL) each of copper chloride, copper nitrate, and sal ammoniac in 1 gallon (3.8 L) of water in a glass container.
- Add 2 ounces (59 mL) of commercial muriatic acid. Apply the solution to the galvanized surface with a wide, flat brush.

- Apply one coat of primer after the surface develops a grey film.
- Spot coat damaged surfaces with primer, once installed.
- Apply two coats of enamel of the color specified below.

Factory-enameled signal heads and fittings of black or dark olive-green in good condition must not require painting. Apply one coat of primer and two coats of enamel to signal heads that are un-painted or when directed.

Use the same color for like components in the same intersection.

Apply one coat of primer to the backplates.

Apply two coats of flat black enamel to hood interiors and front faces of backplates.

Factory-enameled controller cabinet exteriors in good condition do not require painting. Paint unpainted cabinet exteriors with one coat of primer and two coats of aluminum enamel.

Galvanized poles must not require painting except for repairing damaged surfaces.

Apply paint by hand brushing or spray equipment. The Project Manager will require brush painting if spraying produces unsatisfactory results.

#### **617.03.13 Field Test**

Conduct the following tests on traffic signal and lighting circuits with the Project Manager present before completing the work:

1. Test each circuit for continuity;
2. Test each circuit for grounds;
3. Perform a megger test on each vehicle detector loop between the loop and ground before and after sealing. The megger readings must exceed 10 megohms; and
4. A functional test that demonstrates the system functions as specified.

#### **617.03.14 Salvaging and Reinstalling Electrical Equipment**

- A. Salvaging Electrical Equipment.** Remove, clean, salvage, and stockpile or re-install existing electrical equipment as specified.

Underground conduit, conductors, and foundations not reused are the Contractor's property and must be removed. The materials may, with written approval, be abandoned in place.

Replace all electrical equipment damaged or destroyed during salvage operations at Contractor expense.

- B. Reinstalling Salvaged Electrical Equipment.** Furnish and install all necessary materials and equipment to complete the new installation.

- C. Remove and Reset Existing Poles and Standards.** Remove the specified poles and standards, including their attachments from the existing locations and reset them at the specified new locations. Remove the existing foundation, backfill and compact the hole, and dispose of the old foundation. Remove the existing wiring from the poles and standards and replace with new wiring, making all connections. Furnish four high strength anchor bolts, as specified, and two nuts and two washers for each bolt for the new foundation. Ensure the top 12 inches (300 mm) of the bolt is galvanized. Install a new foundation meeting Subsection 703.05 at the specified locations. Meet all the applicable Section 617 requirements for the reset installation.

#### **617.03.15 Road Closure Gate Assemblies**

Furnish and install road closure gate assemblies meeting the contract requirements and as shown in the Detailed Drawings.

**617.04 METHOD OF MEASUREMENT****617.04.1 Lump Sum Basis**

When a traffic signal and lighting system or portion thereof is specified in the contract on a lump sum basis, the system is measured by the lump sum.

**617.04.2 Traffic Signals and Lighting**

Measurement for traffic signals and lighting is made as follows:

1. Conduit and pull boxes are measured under Subsection 616.04.
2. Concrete foundations are measured by the cubic yard (cubic meter) based on plan dimensions. Deductions are not made for the concrete displaced by reinforcing steel, anchor bolts, and conduit. Foundation work includes backfill, furnishing reinforcing steel, electrical bonding, and restoring the surface around the foundation.
3. Cables, conductors, and treated timber poles are measured by the foot (meter) to the nearest foot (0.1 m), in place.
4. The following items are measured by the unit:
  - Standards
  - Controller Cabinet Pedestals
  - Controllers
  - Luminaire Assemblies
  - Service and Control Assemblies
  - Photoelectric Controls
  - Traffic Signals
  - Pedestrian Signals
  - Signal Standards
  - Detector Loops
  - Detector Loop Amplifiers
  - Pedestrian Push Buttons
  - Emergency Pre-emption Systems
  - Road Closure Gate Assemblies
  - Remove and Reset Existing Pole (foundation measured separately)
  - Other component parts as specified in the contract

**617.05 BASIS OF PAYMENT**

Payment for the completed and accepted quantities is made under the following:

<b><u>Pay Item</u></b>	<b><u>Pay Unit</u></b>
Traffic Signal and Lighting System	Lump Sum
Conduit and Pull Boxes	See 616.05
Concrete	Cubic Yard (cubic meter)
Cables	Foot (meter)
Conductors	Foot (meter)
Treated Timber Poles	Foot (meter)
Pull Boxes	Each
Standards	Each
Controller Cabinet Pedestals	Each
Controllers	Each
Luminaire Assemblies	Each
Service and Control Assemblies	Each
Photoelectric Controls	Each

Traffic Signals	Each
Pedestrian Signals	Each
Signal Standards	Each
Detector Loops	Each
Detector Loop Amplifiers	Each
Pedestrian Push Buttons	Each
Emergency Pre-emption Systems	Each
Road Closure Gate Assembly	Each
Remove and Reset Existing Pole	Each
Other Components as specified in the contract	Each

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract and to furnish and operational system.



## **SECTION 618**

### **TRAFFIC CONTROL**

#### **618.01 DESCRIPTION**

This work is the furnishing, installing, and maintaining of traffic signs, barricades, lights, signals, pavement markings, and other specified traffic control devices. It includes flagging and pilot car operation and furnishing and applying water for dust control.

#### **618.02 MATERIALS**

Furnish materials meeting the contract, the MUTCD, and the following Subsection requirements:

Reflective Sheeting .....	704.01.10
Letters, Symbols and Accessories .....	704.01.11
Temporary Pavement Marking Tape .....	714.01
Temporary Pavement Marking Tabs.....	714.02
Preformed Plastic Pavement Markings.....	714.03
Temporary and Interim Traffic Paint .....	714.04
Signs and Channelizing Devices .....	715.01
Portable Sign Support Assemblies .....	715.02
Advance Warning Arrow Panels .....	715.03
Warning Lights.....	715.04
Flagger Ahead Warning Signs .....	715.05

Provide work zone traffic control devices that meet the National Cooperative Highway Research Council test Report 350 (NCHRP 350) crash test requirements.

#### **618.03 CONSTRUCTION REQUIREMENTS**

##### **618.03.1 Purpose and Prosecution of Work Zone Traffic Control**

Schedule construction and provide work zone traffic control to accomplish the following:

1. To provide the protection, safety, and convenience for motorists, pedestrians and for construction personnel protection and safety; and
2. To advance the project work in the most beneficial manner to the public.

Provide work zone traffic control for all construction activities on the roadway and within the clear construction zone and other specified areas. The construction clear zone is the area within 30 feet (9.2 m) of the edge of a traffic lane.

Furnish work zone traffic control meeting the contract requirements, the MUTCD, and the approved traffic control plan.

##### **618.03.2 Traffic Control Plan**

The Detailed Drawings and the Manual of Uniform Traffic Control Devices provide traffic control requirements for the contract.

Furnish a proposed traffic control plan.

The traffic control plan must consist of; copies of the Detailed Drawings with notations indicating permanent or temporary sign mounting, sign location modifications as necessary, or Contractor generated traffic control drawings. Indicate on the plan the location and purpose of flaggers and pilot car use. Include in the plan proposed measures to deal with traffic delays due to emergencies, highway incidents within the project limits, emergency vehicles, mail delivery, and scheduled school bus runs.

Obtain the Project Managers approval of the plan, and changes to the plan, before its use.

Furnish documentation that each type of traffic control device to be used on the project meets NCHRP 350 requirements with the proposed traffic control plan.

#### **618.03.3 Traffic Control Conference**

Attend a work zone traffic control conference organized by the Project Manager before starting work that alters the public's use of any roadway. The provisions for traffic control proposed for each stage of construction will be reviewed.

#### **618.03.4 Traffic Control Reviews**

Designate personnel to be responsible for traffic control work and its continuous surveillance. The designees must be available 24 hours a day to respond to calls concerning damage to traffic control devices from any cause. Provide the names of the persons responsible for the surveillance.

The Project Manager and the designees will conduct periodic reviews of the traffic control throughout the work to insure compliance with the traffic control plan. The reviews will be conducted at night, during adverse weather conditions, when construction work is active and inactive, and at other times as necessary.

#### **618.03.5 Traffic Control General Requirements**

Meet all traffic control plan requirements before starting work affecting the roadway. Use devices that are new or like new in condition.

Properly maintain, clean, and operate devices when in use. Immediately remove the devices when they are no longer applicable to the work. Cover with opaque material or remove all non-applicable signs from the work.

Remove portable traffic control devices when not in use.

Immediately remove existing signs and other traffic control devices on the present traveled way or on connecting state or federal routes to be abandoned when they no longer apply. Assure roadways are always appropriately signed. Turn removed signs over to the Department.

Provide functional traffic lanes with signing and channelizing appropriate to the roadway condition at the close of each work day.

Provide the traffic an un-obscured view of the traffic control devices at all times.

Store or park construction equipment, vehicles, materials, and debris at least 10 feet (3 m) behind guardrail or outside the clear zone. When this is impractical, use approved warning devices and protective measures to delineate the item. Only equipment and materials for immediate use or incorporation into the work may be placed within the clear zone.

Store unused traffic control devices outside the clear zone.

Contractor furnished traffic control devices are the Contractor's property. Traffic control devices furnished by the Department or installed on a force account basis are the Department's property.

Repair or replace all damaged traffic control devices at Contractor expense.

If the Contractor fails to provide the required traffic control, the Project Manager will provide the work and deduct the costs from monies due or that may become due the Contractor.

#### **618.03.6 Access Breaks**

Submit a written proposal on the "Request for Access Break Approval" form, available from the Project Manager, for temporary breaks in Interstate access control or right-of-way fences for approval. See the form for access breaks requiring FHWA approval. Include all information requested on the form.



Provide a written narrative that describes how the traffic control plan addresses traffic safety and minimizes delay to the mainline traffic. Ensure the plan meets the MUTCD and the departments Detailed Drawings requirements.

Do not begin work on the access break until the Department has returned an approved proposal. Obtain the Project Manager's approval for all modifications to the original plan and submit the changes in writing.

Assume all costs associated with the access break including the traffic controls and the restoration of the area once the access break is removed.

#### **618.03.7 Crossing, Entering, and Using Roadways**

- A. General.** Construct temporary approaches and crossings with 10:1 side slopes and include drainage provisions.

Remove all temporary approaches and median crossings once the work is complete. Restore and re-seed disturbed areas.

Do not use areas within the right-of-way as borrow sources or disposal areas for the construction or restoration of temporary approaches.

Operate hauling units with the flow of traffic. Do not operate hauling units on roadway shoulders.

- B. Limited Access and Multiple-lane Roadways.** Use frontage roads and interchanges for equipment access to the Interstate roadway whenever possible.

Do not stop the general traffic on one-way roadways for the convenience of haul units. Use interchanges or a series of appropriate lane closures at temporary access breaks and median crossings for haul-unit operations on one-way roadways.

Haul unit turning movements are restricted to right-turn movements only, when there is access to the project by frontage roads and where left-turn movements by hauling units would pose a hazard to the traveling public.

Submit temporary median crossing proposals for approval. Include the applicable information detailed in Subsection 618.03.7.

Temporary median crossings may be permitted subject to the following guidelines:

1. The distance between any two median crossings, including interchanges, authorized vehicle median crossings, and temporary median crossings must be at least 2 miles (3.2 km).
2. Median crossings must be at least 1,000 feet (305 m) from structures and have a minimum 1,500 feet (458 m) of sight distance at 3.5 feet (1.1 m) above the pavement.
3. Sign median crossings as specified in the contract.
4. When not in use, protect crossings through median barriers by one of the following methods:
  - a. Place an approved impact attenuator at each end of the barrier opening.
  - b. Close the inside lanes to traffic with a controlled lane closure.
  - c. Close the opening by replacing and pinning the median barrier.

- C. Two-lane Roadways.** Always provide at least one functional lane for traffic. Meet Table 618-1 requirements.

**TABLE 618-1**  
**TRAFFIC CONTROL REQUIREMENTS FOR HAULING**  
**UNITS ENTERING OR CROSSING 2-LANE ROADWAYS**

ADT/LOAD FREQUENCY	TRAFFIC CONTROL REQUIREMENT
Less than 2000 ADT	Stop hauling units for traffic
2000 to 5000 ADT/ Less than 50 loads per shift	Stop hauling units for traffic
2000 to 5000 ADT/ More than 50 loads per shift	Provide flaggers to control traffic
More than 5000 ADT	Provide flaggers to control traffic

The Project Manager may adjust the ADT or load frequency at which flagging is required in Table 618-1.

Where flaggers are not required by Table 618-1, the Contractor may use flaggers and traffic control, with Project Manager approval, at Contractor expense.

Limit the number or locations at which flagging is provided at roadway crossings or entrances to:

1. One location per material or plant site; or
2. The number of locations required by an indicated materials source.

#### **618.03.8 Traffic Control at Drop-off Areas**

When existing slopes are 3:1 or flatter, temporarily fill constructed drop-offs within 30 feet (9.2 m) of the edge of travel lanes used by traffic to a 3:1 slope or flatter at the close of work each day. Furnish and install, at Contractor expense, traffic control devices for slopes not temporarily filled to a 3:1 or flatter.

When existing slopes are steeper than 3:1, temporarily fill constructed drop-offs within 30 feet (9.2 m) of the edge of travel lanes used by traffic that matches or is flatter than the existing slope at the close of work each day. Furnish and install at Contractor expense, traffic control devices for slopes not temporarily filled to match, or that are steeper than the existing slope.

Temporary filling of drop-offs protected by positive barriers is not required.

Determine device spacing using the following formula:

$$\text{Factor in Feet (meters)} = \frac{(A \times C \times W)}{(S \times D)}$$

Where:

A = Average Daily Traffic Adjustment

C = Degree of Curvature (metric radius factor)

W = Recoverable Width, 4:1 or flatter, in feet (meters) from the drop-off to the far edge of the adjacent traffic lane(s) with the same direction of traffic

S = Posted Speed in MPH (km/h)

D = Average Drop-off Depth in inches (mm)

Use the C factors in Table 618-2 for drop-offs outside of horizontal curves.

**TABLE 618-2****C - FACTORS FOR DROP-OFFS ON THE OUTSIDE OF HORIZONTAL CURVES**

DEGREE OF CURVE	C	METRIC RADIUS	C
Less than 2	5800	Greater than 900m	241,000
2 to less than 4	5200	900m to more than 450m	218,000
4 to less than 6	4900	450m to more than 300m	203,000
6 or greater	4500	300m or less	188,00

Use the C - factor for curves with a degree of curve less than 2 (greater than 900 m) for drop-offs on the inside of horizontal curves.

Use the Average Daily Traffic (ADT) adjustment from Table 618-3.

**TABLE 618-3****AVERAGE DAILY TRAFFIC ADJUSTMENT FACTOR**

ADT	A
Under 750	1.50
750 - 1499	1.30
1500 - 5999	1.00
Over 6000	0.90

Round the computed spacing to the nearest 10 feet (3 m).

Use Table 618-4 to determine the device type using the spacing factor.

**TABLE 618-4****TRAFFIC CONTROL DEVICE BASED ON SPACING FACTOR**

SPACING FACTOR	DEVICE TYPE
400 feet (122 m) or greater	Flexible guideposts or standard delineators
40 feet (12 m) to 390 feet (119 m)	Type 2 object marker
20 feet (6 m) to 30 feet (9 m)	Type C steady burn warning lights on alternate panels
Less than 20 feet (6 m)	Positive barrier, if 48 hours will lapse before filling

Space devices at the spacing factor. If the recoverable width (W) is less than 14 feet (4 m), do not exceed spacing in feet (m) that is double the posted speed in miles per hour.

Do not space Type 2 object markers less than 40 feet (12 m).

**618.03.9 Traffic Control for Paving and Milling Operations**

Provide flaggers at paving and milling machines. Locate the flagger 100 feet to 150 feet (30 m to 46 m) upstream from the machines.

Meet the following requirements for night paving operations:

- A.** Place a 48-inch x 48-inch (1,220 mm x 1,220 mm) "NIGHT PAVING AHEAD" warning sign in advance of each warning sign series.
- B.** Assure all personnel working on or adjacent to traveled lanes are wearing reflectorized vests or reflectorized exterior clothing. The reflectorized area must be at least 50 square inches (32,260 square mm) of material visible from any direction.

**618.03.10 Reserved**

**618.03.11 Traffic Control for Seal Coat Operations**

- A. Two-lane Two-way and Multiple-lane Two-way Roadways.** Place "LOOSE GRAVEL" (W8-7) signs, each with a 30-inch x 30-inch (760 mm x 760 mm) advisory speed plate "35 MPH" (W13-1), at the beginning of each work zone. Place the same sign combination for each direction of travel at 2-mile (3.2 km) intervals within the work zone. Leave the signs in place until all sweeping and pavement markings within the zone are completed.

Control traffic with pilot cars for up to 72 hours. The 72-hour period for each completed section begins once the seal and cover has been placed and rolling is complete. For this work, a section is defined as the area of seal coat completed in each day of production.

Traffic control beyond 72 hours, unless ordered by the Project Manager, is at Contractor expense.

Provide a roadway free of loose cover material. In curb and gutter sections, remove and dispose of all loose cover material. Correct surface irregularities affecting the ride quality at Contractor expense. Remove all loose cover material and place pavement markings (centerline and edge lines) before terminating pilot car use. If pavement markings are not placed within 72 hours of completion of the seal coat work, the Department will have the work performed and deduct the costs from monies due the Contractor.

Apply final pavement markings as specified elsewhere in the contract.

- B. Interstate Highways.** Use lane closures and lane control devices for seal and cover operations on Interstate highways. Do not use pilot cars unless approved by the Project Manager.

Place "LOOSE GRAVEL" (W8-7) signs, each with a 30-inch x 30-inch (760 mm x 760 mm) advisory speed plate "45 MPH" (W13-1), at the beginning of each work zone. Sign both sides of the roadway.

Remove all loose cover material and place pavement markings (centerline and edge lines) within 72 hours of seal coat completion. If pavement markings are not placed within 72 hours of completion of the seal coat work, the Department will have the work performed and deduct the costs from monies due the Contractor. Apply final pavement markings as specified elsewhere in the contract.

Provide a roadway free of loose cover material. In curb and gutter sections, remove and dispose of all loose cover material. Correct surface irregularities affecting the ride quality at Contractor expense.

Traffic control beyond 72 hours, unless ordered by the Project Manager, is at Contractor expense.

**618.03.12 Traffic Control for Striping Operations**

Provide the following traffic control for striping operations.

- A.** Furnish a shadow vehicle to follow the pavement striping vehicle within 500 feet to 1,000 feet (152 m to 305 m).
- B.** Equip shadow vehicles with an arrow board facing rear-approaching traffic.
- C.** On multiple-lane roadways, place the arrow board display in the sequential arrow mode (lane shift).
- D.** On two-lane two-way roadways, place the arrow board in a hazard warning mode not displaying the lane-shift mode.
- E.** Furnish and operate a shadow truck equipped with a truck-mounted attenuator meeting the National Cooperative Highway Research Council (NCHRP) 350 standards and the appropriate test level. Use the truck to follow within 150 feet to 300 feet (45 m to 90 m) of

pavement marking removal and application, placing and removing traffic cones that protect the pavement markings. Include all costs associated with this work in the respective bid item.

#### **618.03.13 Traffic Control Device Location and Installation**

Lay out the standard distances for traffic control devices to within an accuracy of plus or minus 5 percent. The Project Manager may direct adjustments to the device locations to fit site conditions.

Display all signs with the legend not more than 5 degrees (1 inch per foot) (25 mm per 305 mm) from the horizontal plane.

Display the signs at the required mounting height with the hinged signs closed or non-hinged signs removed when not applicable.

Use only one type of reflective sheeting in each sequence or group of signs or devices.

Stabilize sign trailers to prevent movement by wind or passing vehicles.

Assure the G20-1 ("ROAD CONSTRUCTION NEXT (X) MILES) and G20-2 (END CONSTRUCTION) signs do not conflict with other construction signing. Remove these signs when directed.

Post-mount work zone traffic control devices to remain at the same location for more than three consecutive days. Trailer-mounted W20-7a (flagger ahead) signs with generators are excluded from this requirement.

Install work zone traffic control devices sequentially toward the work area beginning with the device located farthest from the work area. Remove sequentially in the opposite direction.

Use arrow boards in the sequential or flashing-arrow mode to supplement channelizing devices and standard signing when one or more lanes of a multiple-lane roadway are closed.

Do not use arrow boards in the sequential or flashing-arrow mode for lane closures or at flag stations on two-lane two-way roadways.

Do not use flexible guide posts in place of the specified hazard identification devices for shoulder drop-offs or other hazards adjacent to the travel lanes. Refer to Subsection 618.03.8.

Flexible reflectorized warning signs are acceptable for daylight hour use.

Do not use traffic cones for channelization devices.

Do not use steel barrels for work zone traffic control.

Ensure that construction zone and work zone speed limits signs comply with the desired minimum speed limit values in Table 618-5. The Project Manager may direct adjustments to the speed limits or device locations to fit the conditions.

Submit a written recommendation if the Contractor's proposed limits differ from those in Table 618-5. Give the locations and reasons for limits differing from those provided in Table 618-5. Reasons should be based upon the conditions of the roadway and the ability of traffic to flow safely and uniformly through the construction zone or activity area. The Project Manager will provide a written response to the recommendation, detailing the speed limit signs to be used.

**TABLE 618-5**  
**TRAFFIC CONTROL SPEED LIMITS IN CONSTRUCTION ZONES**

<b>SPEED LIMIT</b>	<b>ACTIVITY DESCRIPTION</b>
Normal Limit	Construction activities are 30 feet (9.2 m) beyond the edge of the traveled way and construction vehicles are not crossing the traveled way.
65 mph	Two way traffic on Interstates.
45 mph	Two and four-lane roadways with construction activity adjacent to roadway but not encroaching on the roadway surface (shoulders and driving lanes).
35 mph	Seal and cover for two-lane two-way and multiple-lane two-way roadways.
35 mph	Four-lane roadways with construction activity in one lane or two-lane roadways with activity on the shoulders (only applies within construction activity areas).
45 mph	Seal and cover for Interstate.
35 mph	Paved roadways with a short temporary detour over a gravel surface. This speed limit only applies within detour areas. The design speed of the detour geometrics should be at least 35 mph.
35 mph	In advance of flagging stations.
25 mph	Two or four-lane roadways in an urban area with construction activity in a lane.
25 mph	Survey crew activity when survey crew has to occupy a portion of the traveled way.
35 mph	Survey crew activity requires occupying a portion of the shoulder. This speed limit only applies within the survey activity areas.
Normal Limit	Survey crew activities are not on the highway or parking shoulder.

#### **618.03.14 Flagging Operations**

Provide flaggers that are currently certified by the Montana flagger training program, the ATSSA flagger program, or Idaho, Oregon, or Washington state flagger training programs.

Provide flaggers that are competent and equipped as required in the Department's booklet "Flaggers Handbook" furnished by the Department.

Maintain constant radio contact between flaggers at each end of a work zone and pilot vehicles when visual contact is not possible. Use two-way V.H.F. or U.H.F. FM radios, operable in the terrain.

Place the W20-7a (flagger ahead) warning sign signals so they are visible 2,000 feet (610 m) in advance of the sign. Place and operate the sign only when a flagger is at the flag station.

Use reflectorized flagger devices and garments for night work. Furnish lighting that makes the flaggers clearly visible from 500 feet (153 m).

Provide a second flagger when more than 10 vehicles are stopped at a flag station 50 percent of the time to advise traffic of the delay. Place an additional W20-7a sign 500 feet to 1,000 feet (153 m to 305 m) ahead of the average end of the stopped vehicle line.

#### **618.03.15 Pilot Car Operations**

Use pilot cars as specified. Equip the cars with amber flashing lights, flags, and the G20-4 sign designated in Part VI of the MUTCD. Mount the sign in a conspicuous position on the vehicle with the bottom sign edge at least 6 feet (1.8 m) above the ground.

Schedule and cycle pilot vehicles to depart each flag station at maximum 15-minute intervals.

**618.03.16 Water for Dust Control**

Furnish, haul, and apply dust control of water using tank trucks equipped with spray systems that uniformly distributes the water over the application area. Discontinue watering as directed.

**618.04 METHOD OF MEASUREMENT**

The estimated contract quantities for traffic control devices, temporary pavement markings, flagging, and pilot car operation are an estimate only and may vary from the actual quantities used or required in the contract. No additional compensation is considered or allowed due to these quantity differences.

**618.04.1 Traffic Control Devices**

Traffic control devices are measured by the units of traffic control devices used and accepted. A unit of traffic control device is the base value used for establishing the relative value of each type of traffic control device. The relative value of each traffic control device in units is shown in the "Traffic Control Rate Schedule" included in the contract.

Signs and devices must be in new or like-new condition to be measured for payment.

**618.04.2 Reserved****618.04.3 Flagging**

Flagging is measured by the hour for the actual number of approved flagging hours provided on the project for each flagger used.

Travel time for flaggers to and from the project is not measured for payment.

**618.04.4 Pilot Car Operation**

Pilot car operation is measured by the hour for the approved number of hours of operation for each properly equipped pilot car.

**618.04.5 Water for Dust Control**

Dust control water is measured by the 1000 gallon (1 KL) unit used and accepted.

Measurement will be by an approved meter, load counter or by manual count of the number of loads of a known quantity applied on the roadway.

No measurement is made of water used other than for dust control for environmental compliance and convenience for the traveling public.

**618.04.6 Items Not Eligible for Separate Payment**

The following items are not measured or paid for separately:

- Amber flashing or strobe lights on equipment, vehicles, and hauling units;
- Impact attenuators for median barrier openings;
- Permits and costs relating to project access;
- Construction, drainage, maintenance, removal, restoration and reseeding of areas used for temporary roads, approaches, and crossovers;
- Radios for flaggers and pilot vehicles;
- Illumination of flag stations and work areas;
- Reflectorized safety equipment, garments, and headgear;
- Vehicle-mounted arrow boards on stripers and shadow vehicles;
- Replacing temporary pavement marking tabs and tape destroyed by traffic;
- Temporary pavement marking tabs used for seal coat operations;
- Costs to clean and maintain installed traffic control devices;
- Covering or removing non-applicable signs or signs not in use; and

- Other miscellaneous materials and equipment required for proper traffic control that are not included in the "Traffic Control Rate Schedule".

## 618.05 BASIS OF PAYMENT

### 618.05.1 Traffic Control Devices

Payment for the completed and accepted quantities is made under the following:

<u>Pay Item</u>	<u>Pay Unit</u>
Traffic Control Devices	Unit
Temporary Pavement Markings	Mile (kilometer)

Traffic control devices are paid for at the contract unit price per unit of traffic control devices. The units of each type of traffic control device paid for are calculated by multiplying the measured quantity of each device by the value per each unit shown in the traffic control rate schedule.

Traffic control devices are bid competitively. If the actual quantities required for traffic control devices exceed the plan quantity on the project by more than 15 percent, the price paid per unit for all quantities that exceed 115 percent of plan quantity will be the lesser of the contract unit price or \$0.80.

Payment for traffic control devices is made for each setup directed by the Project Manager.

The following devices are not eligible for payment:

1. Devices placed beyond 1,500 feet (458 meters) of the work termination point for that day.
2. Adjustments or moving of devices that were initially installed improperly.
3. Adjustments or moving of devices for the convenience of the Contractor.

Replacing properly installed traffic control devices destroyed by traffic is paid for at the contract unit price per unit of traffic control devices.

Payment for barricades and drums includes the required ballast.

Payment for signs mounted on barricades is made only for the original mounting.

Payment for flashing arrow boards is made only for the actual hours of operation approved by the Project Manager. Payment includes the cost of operating the trucks or trailers on which the arrow boards are mounted.

Paint stripe removal is paid for at the contract unit price per unit of traffic control devices.

Store devices in approved staging areas with a maximum of one staging area per three-mile segment of roadway. Detail the staging areas in the traffic control plan submitted for the Project Manager's approval. All devices not stored in the approved staging areas will be paid for at category #2 payment amounts and all portable signs not stored in approved staging areas will be paid for at 50 percent of the contract unit price.

Payment for traffic control devices will be made under one of the following two categories:

1. **Category #1 - Standard Installation.** The initial setup for the project or a new operation, or the moving of a device, and the setup of the device requires it be loaded in a truck (vehicle) or hitched to a truck (vehicle) for moving to a new location.
2. **Category #2 - Adjustments.** The manual moving of a device conducted by dragging, carrying, etc. of the device required to move it to a new location of a traffic control operation.

Payment for traffic control devices will be paid for at the rates listed in Table 618-6 according to the category and device type.



**TABLE 618-6**  
**TRAFFIC CONTROL RATES BASED ON CATEGORY AND DEVICE TYPE**

<b>CATEGORY #</b>	<b>DEVICE</b>	<b>PAYMENT AMOUNT PERCENT</b>
1	Flexible Guide Post	100
1	Barrels	100
1	Portable Signs	100
1	Type III Barricades	100
1	Portable Vertical Panels	100
1	Other	100
2	Flexible Guide Posts	50
2	Barrels	50
2	Type III Barricades	25
2	Portable Vertical Panels	50
2	Other	50

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.



## SECTION 619

### SIGNS, DELINEATORS, AND GUIDEPOSTS

#### 619.01 DESCRIPTION

This work is furnishing, fabricating, erecting, removing, and resetting signs, delineators, and guideposts.

#### 619.02 MATERIALS

Furnish materials meeting the Detailed Drawings and the following Subsection requirements:

Signing Material .....	704.01
Guideposts.....	704.03
Delineators.....	Detailed Drawings

#### 619.03 CONSTRUCTION REQUIREMENTS

##### 619.03.1 Definitions

The following definitions apply to the signing work in the contract.

- A. New.** Signs designated "New" are to be furnished new and erected on new supports at the specified locations.
- B. Reuse.** Signs designated "Reuse" are to be removed from the existing supports and remounted on new supports at the specified locations.
- C. Replace.** Signs designated "Replace" are to be removed and replaced with the specified new signs, including new supports, at the existing or specified new locations.
- D. Replace Sign Face.** Signs designated "Replace Sign Face" are to be removed from the supports and replaced with the specified new signs using the existing supports.
- E. Use As Is.** Signs designated "Use As Is" are to be left in place.
- F. Reset.** Signs designated "Reset" are to be removed and reset at the specified locations using the existing sign faces and supports.
- G. Remove.** Signs designated "Remove" are to be removed, including the sign or sign assembly and sign supports.

##### 619.03.2 Design Calculations and Shop Drawings

The Department will furnish the sign design calculations for the project at the pre-construction conference. The furnished sign design calculations must include the calculations for the specified guide signs, special design signs, and other signs shown in the Montana Sign and Sign Materials book but not include those signs in the FHWA Standard Highway Signs Book.

Submit Contractor approved (stamped) shop drawings and welding procedures for sign bridges, and overhead cantilever sign structures. Submit shop drawings on minimum size 11-inch x 17-inch sheets (A3 paper); welding procedures on 8 1/2-inch x 11-inch (A4 paper) sheets.

The Department has 15 working days upon receipt of the drawings for drawing review. Drawings returned to the Contractor for corrections or additional information must be re-submitted within 15 working days of receipt.

After the structural steel shop drawings and welding procedures have been reviewed and checked by the Department, all required corrections will be returned to the Contractor who must make the corrections and re-submit ten copies of the corrected drawings and welding procedures for final review and approval within 15 days. All final drawings must be stamped "Approved" by the Department before fabrication begins.

Submit shop drawings and current approved weld procedures for tubular sign posts and structural steel sign posts.

The Department Inspector will compare the drawings and weld procedures to the posts during post inspection at the point of fabrication. Submit weld procedures for approval every six months or whenever they are changed or modified.

Submit shop drawings and welding procedures at one time in a complete package for the Department's initial and subsequent reviews. Individual parts of the submittals will not be accepted for review.

### **619.03.3 Fabrication and Erection**

Fabricate the signs and sign legends before delivery to the project, except for signs too large to transport in one piece to the project.

Fabricate all signs using the hole spacing specified in the FHWA Standard Highway Signs Book or the Detailed Drawings.

The lengths of poles and steel posts shown in the contract are estimated lengths. The Project Manager will furnish the required length of each pole and steel post prior to fabrication.

Locate and erect signs as specified or directed. The Project Manager may change sign locations due to field conditions. Erect signs so the sign face is vertical and aligned as specified. Sign supports must not project above the sign faces.

Submit two copies of the manufacturers installation instructions for all sign post breakaway devices installed on the project to the Project Manager at least 15 calendar days prior to installation.

After the sign is installed and adjustments are made, jam the threads of the mounting bolts or use vandal resistant nuts for ground-mounted sign faces 25 square feet (2.3 square meters) and smaller.

The specified foundation depth for timber poles is a minimum depth. Field cut the poles to the correct length or bury the extra length to provide the specified mounting.

Excavate or bore foundation holes for sign supports at least 8 inches (205 mm) larger than the largest diameter of post placed in each hole.

Backfill foundation holes for timber posts and poles as follows:

- Combine and thoroughly mix the material excavated from the foundation with portland cement using a mix ratio of 10 parts excavated material to 1 part cement.
- Do not mix in the hole. Add water to make the soil-cement mixture.
- Place the sign post or pole in the hole without the sign attached.
- Backfill the hole with the soil-cement mixture in 8-inch (205 mm) maximum lifts.
- Compact each lift by hand tamping or using mechanical methods.
- Allow the foundation to cure for seven days before mounting the sign face to the support.

Foundation holes for wooden sign supports may be backfilled with Class "F" portland cement concrete using the specifications for backfilling foundations for steel sign posts as follows.

Backfill foundations for steel sign posts with Class "A" or "D" concrete finished flush with the adjacent surface. Signs may be post mounted after the concrete has set seven days.

Weld metal joints and post breaks meeting Section 556 requirements.

### **619.03.4 Inspection**

The completed signs will be inspected at the fabricator's plant and on the project before they are installed. Defects including but not limited to cracks, tears, splits, crazing, gouges or curled edges of the background sheeting or legend are cause for rejecting the sign. The installed signs

will be inspected at night for nighttime reflectivity and readability. Adjust signs exhibiting specular reflection, as directed.

#### **619.03.5 Sheet Aluminum Overlay**

Meet the contract requirements for sheet aluminum overlays.

Install the sign legend and other components plumb and level. Match the color, shade, and type of existing reflective sheeting used as a background for partial overlays. Fully cover the existing legend and symbols with partial overlay backgrounds. Match the size of the existing sign with complete overlay backgrounds.

#### **619.03.6 Replace, Reuse, and Reset Signs**

Use new materials meeting Section 704 requirements for that required over and above those materials salvaged from signs to be reset or reused.

Install breakaway devices on existing posts when specified.

Reset signs meeting Subsection 619.03.3 requirements.

Repair or replace all Contractor sign damage resulting from dismantling, moving, and resetting at Contractor expense.

With no exception, remount or reset within one hour all removed warning, regulatory signs and route markers. Re-install guide signs within five hours and only during daylight hours. Re-display warning, regulatory, and guide signs by dusk.

Remove foundation material left after removing the existing signs to at least 1 foot (305 mm) below groundline. Fill resulting holes level with the adjacent ground.

Existing signs and supports specified for removal are the Contractor's property. Disassemble and store signs specified to remain the Department's property at the designated location.

Erect the new sign and support before removing the existing sign being replaced. Do not display conflicting signs together. Do not obscure existing signs when placing new signs.

Re-erect existing multiple support signs to be removed and reset using the original post spacing.

#### **619.03.7 Installation Date Tags and Route Markers**

Install date tags and route identification tags on all highway signs before final acceptance.

Meet the contract requirements for design, color, and installation.

#### **619.03.8 Delineators**

Furnish and install new delineators at the locations specified and marked by the Project Manager. Remove delineators conflicting with new construction as specified.

Removed delineators are the Contractor's property.

#### **619.03.9 Guideposts**

Install guideposts at the specified locations.

#### **619.03.10 Acceptance**

Signs and traffic guide devices are accepted for payment individually or in lots as completed work once installed.

Delineator posts with reflectors are accepted in lots of 100 or more units.

Guide, directional, and warning signs with a surface area of up to 10 square feet (0.93 square meters) on one side are accepted in lots of 25 or more.

Signs with a surface area of up to 30 square feet (2.8 square meters) on one side are accepted in lots of five or more.

Overhead structures and signs larger than 30 square feet (2.8 square meters) in sheeting area are accepted individually.

The Department will assume maintenance responsibility for signs and other traffic guide devices once accepted and in place.

Repair or replace signs and devices, at Contractor expense, that are damaged or destroyed by the Contractor's operations.

#### **619.03.11 Permanent Barricade**

Furnish and install permanent barricades as specified and shown in the Detailed Drawings.

### **619.04 METHOD OF MEASUREMENT**

#### **619.04.1 Aluminum and Plywood Signs**

Aluminum sheet, aluminum sheet increment, and plywood signs are measured by the square foot (square meter) to the nearest 0.1 square foot (0.1 square meter) of sign face.

#### **619.04.2 Metal Posts**

Metal posts are measured by the pound (kilogram). The pay weight is calculated by multiplying the nominal weight per foot (meter) by the installed length of each post from the top of the breakaway device up.

If there is no breakaway system bid item, include in the post weight the breakaway device, fuse plate, and stub post including the embedment length.

Breakaway systems, bid as a separate item, are measured per each and include the breakaway device, fuse plate, and stub post including the embedded length.

#### **619.04.3 Treated Timber Poles and Posts**

Treated timber poles and posts are measured by the foot (meter) in even 2-foot (610 mm) increments. When the measurement falls between increments, the measured length for payment is the next higher 2-foot (610 mm) increment.

#### **619.04.4 Delineators and Reference Markers**

Delineators and reference markers of each type specified are measured by the unit and include the reflector, reference sign, mounting hardware, and post, complete in place.

Removal of the existing delineators and reference markers is not measured for payment.

#### **619.04.5 Guideposts**

Guideposts of each type specified are measured by the unit.

#### **619.04.6 Reset Signs**

Guide and reset signs - warning, regulatory, and route markers are measured by the unit for each sign removed and reset in a new location.

Sign groups of two or more signs mounted on a single support or multiple supports are measured as a single sign.

When there is not a bid item in the contract for reset sign, this work is incidental to other items of the contract.

#### **619.04.7 Remove Signs**

Remove signs - guide and remove signs - warning, regulatory, and route markers are measured by the unit for each sign removed including supports.

Sign groups of two or more signs mounted on a single support or multiple supports are measured as a single sign.

**619.04.8 Replace Signs**

New materials for signs designated "Replace" are measured under Subsections 619.04.1, 619.04.2, and 619.04.3.

Removal of existing signs designated "Replace" are measured under Subsection 619.04.7.

New materials for signs designated "Replace Sign Face" are measured under Subsection 619.04.1.

**619.04.9 Reuse Signs**

New material for supports for signs designated "Reuse" is measured under Subsections 619.04.2 and 619.04.3.

Removal of existing signs designated "Reuse" is measured under Subsection 619.04.7.

**619.04.10 Sheet Aluminum Overlay**

Sheet aluminum for signs designated "Sheet Aluminum Overlay" is measured by the square foot (square meter) to the nearest 0.1 square foot (0.1 square meter) of sign face complete in place.

**619.04.11 Lump Sum Basis**

When a signing system or portion thereof is specified in the contract on a lump sum basis, the system is measured by the lump sum.

**619.04.12 Permanent Barricade**

Permanent barricade, as shown in the Detailed Drawings, is measured by the foot (meter) of the barricade width and includes all materials for the barricade.

**619.05 BASIS OF PAYMENT**

Payment for the completed and accepted work is made under the following:

<b><u>Pay Item</u></b>	<b><u>Pay Unit</u></b>
Aluminum and Plywood Signs	Square Foot (square meter)
Metal Sign Post	Pound (kilogram)
Breakaway System	Each
Timber Sign Post	Foot (meter)
Delineator and Reference Markers	Each
Guideposts	Each
Reset Signs	Each
Remove Signs	Each
Sheet Aluminum Overlay	Square Foot (square meter)
Sign System	Lump Sum
Permanent Barricade	Foot (meter)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work, including excavation and backfill, concrete foundation, miscellaneous hardware, welding, date tag and route identification tags and installation under the contract.





## **SECTION 620**

### **PAVEMENT MARKING APPLICATION**

#### **620.01 DESCRIPTION**

This work is the application of temporary, interim and final pavement markings.

Temporary pavement markings consist of the centerline markings for two-lane two-way roadways; lane line markings for divided four-lane two-way Interstates, and centerlines and lane lines for two-way undivided three or more lane urban roadways. Divided roadways are roadways where the paved surface for each direction of travel is physically separated by an unpaved section.

Interim pavement markings consist of all longitudinal pavement markings (centerlines, edge lines (shoulder lines), lane lines, etc.) and words and symbols identical to the final pavement marking configuration.

#### **620.02 MATERIALS**

Furnish materials meeting the following Subsection requirements:

Temporary Pavement Marking Tape .....	714.01
Preformed Plastic Pavement Marking Material.....	714.03
Temp and Interim Traffic Paint.....	714.04
Epoxy Pavement Marking .....	714.08
Reflective Glass Beads.....	714.05
Reflective Thermoplastic Pavement Markings.....	714.06

Furnish hot inlaid hydrocarbon-based thermoplastic for all plastic pavement marking bid items unless otherwise specified.

#### **620.03 CONSTRUCTION REQUIREMENTS**

##### **620.03.1 General**

Furnish a manufacturer's material certification. Do not apply materials that do not meet the contract requirements. The Project Manager may request a manufacturer's sample or take field samples for testing. Furnish a material sample weighing at least 2 pounds (0.91 kg). Provide five calendar days advance notice before striping work begins.

##### **620.03.2 Layout of Pavement Markings**

Be responsible for establishing all horizontal controls for line placement. The Project Manager will check the layout of the final striping before placement begins.

Establish and maintain pavement marking control lines within 0.25 feet (75 mm) of the true line.

Apply the centerline and shoulder lines within 0.30 feet (90 mm) of the true line. Ensure the stripe does not deviate by more than 0.15 foot (50 mm) in 500 feet (152 m).

The Project Manager will select a random location for each mile to check accuracy of the applied markings.

Remove and replace out of specification pavement markings as directed at Contractor expense.

##### **620.03.3 Temporary and Interim Pavement Markings**

**A. Materials.** Furnish materials meeting Subsection 714.04 requirements.

**B. Equipment.** Use equipment manufactured to apply the material type. Ensure the equipment prevents paint spray or bead loss outside the specified line width. Equip the

pavement-marking machine with a flow meter and totalizer that measures paint quantities in gallons (liters), to the nearest 0.1 gallon (0.1 L). Calibrate the flow meter before use on the project and when directed. Locate the flow meter in the flow line to the spray nozzles. Locate the totalizer where it can be easily read. Ensure the calibration adjustment is accessible without meter removal or using a calibration adjustment device.

Marking material quantities will be verified by measuring equipment's calibrated paint tank(s) and the tank manufacturer's measuring device. The Project Manager will visually witness tank stabs at the beginning and end of each work shift, any time additional paint is added to the tank, at the beginning and end of each route/road segment on contracts with multiple route/road segments, at the beginning and end of each certified paint lot, and at other intervals as necessary. In the event that there is a difference between the totalizer and tank stab measurements, the lesser quantity will be used for payment.

Submit calibration certificates from an independent agent for the paint tank. Re-certify the tank at the beginning of each year before using the equipment on Department contracts. The Project Manager may inspect the tank before each use and as determined necessary.

Stop bars, crosswalks, and symbols may be applied with hand-operated equipment.

Terminate marking application when the equipment fails to apply the markings meeting the contract requirements. Make equipment adjustments and resume striping.

- C. Surface Preparation and Weather Limitation.** Clean the surface to be painted meeting the paint manufacturer's recommendations. Inform the Project Manager and modify, when required, the surface preparation to ensure optimal bonding of the marking to the surface and to provide the specified marking requirements.

Apply the material following the paint manufacturer's recommendations.

Apply pavement markings during daylight hours only. Obtain approval to apply pavement markings any other time.

- D. Application.** Apply the markings to within  $\pm 1/4$  inch (6 mm) of the specified width.

- 1. Temporary Pavement Markings.** Apply a 10 mil  $\pm 1$  mil (0.254 mm  $\pm$  0.025 mm) thick wet film immediately followed by applying at least 6 lbs/gallon (0.72 kg/L) of glass beads to temporary pavement markings on all sections of newly constructed pavement before opening to traffic. This includes detours, transitions, and all pavement lifts open to traffic. Temporary pavement markings may be used for a maximum 10 calendar days on pavements under traffic.

Remove, at Contractor expense, all temporary pavement markings that conflict with interim or final pavement markings. Remove conflicting temporary stripe(s) the same day the interim or final markings are applied.

- 2. Interim Pavement Markings.** Apply a 16 mil  $\pm 1$  mil (0.406 mm  $\pm$  0.025 mm) thick wet film immediately followed by applying at least 8 lbs/gallon (0.96 kg/L) of glass beads. Apply interim pavement markings no later than 10 calendar days after the application of temporary pavement markings.

Stripe newly constructed pavements, including partially completed sections. Apply the interim pavement markings matching the final pavement marking configurations and locations. Interim pavement markings placed prior to chip seal may be offset as approved by the Project Manager.

The Project Manager will suspend all remaining contract work if the interim striping is not applied within the time specified above.

**620.03.4 Pavement Marking Tape**

Furnish Materials meeting subsection 714.01. Follow the tape manufacturer's recommendations for road surface preparation and installation. Install the tape meeting the contract requirements.

**620.03.5 Preformed Plastic Pavement Marking Materials**

Apply pavement markings up to 8 inches (205 mm) wide in a single application to the specified width. Apply pavement markings over 8 inches (205 mm) wide in 6-inch or 8-inch (155 or 205 mm) multiple applications and minimum fractional 4-inch (100 mm) applications.

Apply the marking material at the thickness specified in the contract.

Cut and true the marking material edges.

Apply inlaid plastic pavement marking materials into the new asphalt pavement just before final compaction and roll it flush with the roadway surface during the final plant mix compaction.

**620.03.6 Epoxy Pavement Markings**

**A. Materials.** Furnish Materials meeting Subsection 714.08 requirements.

**B. Equipment.** Ensure the epoxy application equipment accurately meters the two components and produces and maintains the mixing head temperature, all meeting the epoxy manufacturer's specifications. Ensure the application equipment is acceptable to the marking manufacturer.

Use equipment manufactured to apply the material type. Ensure the equipment prevents paint spray or bead loss outside the specified line width. Equip the pavement-marking machine with a flow meter and totalizer that measures paint quantities in gallons (liters), to the nearest 0.1 gallon (0.1 L). Calibrate the flow meter before use on the project and when directed. Locate the flow meter in the flow line to the spray nozzles. Locate the totalizer where it can be easily read. Ensure the calibration adjustment is accessible without meter removal or using a calibration adjustment device.

Marking material quantities will be verified by measuring equipment's calibrated paint tank(s) and the tank manufacturer's measuring device. The Project Manager will visually witness tank stabs at the beginning and end of each work shift, any time additional paint is added to the tank, at the beginning and end of each route/road segment on contracts with multiple route/road segments, at the beginning and end of each certified paint lot, and at other intervals as necessary. In the event that there is a difference between the totalizer and tank stab measurements, the lesser quantity will be used for payment.

Submit calibration certificates from an independent agent for the paint tank. Re-certify the tank at the beginning of each year before using the equipment on Department contracts. The Project Manager may inspect the tank before each use and as determined necessary.

Stop bars, crosswalks, and symbols may be applied with hand-operated equipment.

Terminate marking application when the equipment fails to apply the markings meeting the contract requirements. Make equipment adjustments and resume striping.

**C. Surface Preparation and Weather Limitation.**

**1. General.** Clean the surface to be painted meeting the paint manufacturer's recommendations. Inform the Project Manager and modify, when required, the surface preparation to ensure optimal bonding of the marking to the surface and to provide the specified marking requirements.

Apply pavement markings during daylight hours only. Obtain approval to apply pavement markings any other time.

Grind all surfaces within 10 calendar days before applying the pavement marking.

Grinding is surface abrasion 30 mils  $\pm$  10 mils (0.762 mm  $\pm$  0.254 mm) deep to provide a roughened surface free of loose paint chips, loose seal aggregate and surface debris. Removal depth is measured vertically, from the bottom of a three-foot (0.92 meter) or longer straight edge placed on the roadway surface, to the ground surface. Immediately stop grinding if the depth exceeds 40 mils (1.016 mm) and make adjustments to meet the specified grind depth.

2. **Concrete Surfaces.** Prepare existing concrete surfaces meeting (1) above. Grind concrete surfaces 20 mils  $\pm$  10 mils (0.508 mm  $\pm$  0.254 mm) deep to provide a roughened surface free of loose paint chips and surface debris. Do not grind and apply pavement markings on concrete until 15 calendar days after new concrete has been placed.
3. **Removal Limits.** Meet the following removal limits:
  - Do not grind more than 1 inch wider (25 mm) than the existing stripe.
  - Do not grind more than 4 inches (100 mm) from the beginning or end of the stripe being removed.
4. **Disposal.** Collect and dispose of all removed material and new traffic marking materials spilled during the work. Process, handle, transport, and dispose of the materials meeting the current applicable solid waste laws and regulations.

**D. Application.**

1. Apply epoxy pavement markings a minimum of 30 calendar days, and a maximum of 45 calendar days, after seal coat operations through sweeping are completed. When epoxy pavement markings are the only remaining item of work on the project, contract time assessment will be suspended until either, beginning epoxy pavement marking application, or 45 calendar days elapse after seal coat operations are completed.
2. Submit a copy of the manufacturer's instructions for surface preparation and material application.

Include in the instructions:

- Equipment Requirements
- Approved Work Methods and Procedures
- Material Application Range
- Ambient & Surface Temperature Requirements
- Weather Limitations
- Precautions
- All other requirements for successful application and material performance.

Do not place materials before furnishing complete instructions to the Project Manager.

Apply a 20-mil  $\pm$  2 mil (0.508 mm  $\pm$  0.051 mm) thick wet film immediately followed by applying at least 25 lbs/gallon (3 kg/L) of glass beads to the epoxy.

Immediately terminate striping application if the applied stripe(s) are less than 18 mils thick. Grind all 18-mil and thinner striping meeting Subsection 620.03.6(C) and replace the striping meeting the contract requirements at Contractor expense. Correct all deficient striping before continuing with the remaining striping work. The Project Manager will identify deficient stripe thickness by comparing the tank quantities measured and used against the length, width, and application rate of the applied stripe.

Apply the epoxy pavement marking material when the pavement is dry and the ambient temperature is 40 °F (4.4 °C) and rising or follow the manufactures surface and temperature requirements, whichever is more restrictive.

Match the existing pavement marking configuration unless otherwise specified or directed.

- E. Marking Protection.** Furnish all traffic control necessary to protect the new stripe until it does not track. Include the traffic control costs in the contract unit price of the pavement marking.

#### **620.03.7 Thermoplastic Pavement Marking**

- A. General.** The applicable requirements of Subsection 620.03.1 apply to placing thermoplastic marking material.

- B. Material Acceptance.** Furnish a copy of the manufacturer's product specification data.

Do not place materials before furnishing complete specifications.

Do not apply materials not meeting the contract requirements.

The Project Manager may request a manufacturer's sample or take field samples at the point of application for testing.

The Department may test samples for one or any combination of the specified requirements.

Remove and replace material represented by failing samples at Contractor expense.

- C. Manufacturer's Instructions.** Submit the manufacturer's instructions for surface preparation and material application.

Include the following:

- Equipment Requirements;
- Work Methods and Procedures;
- Material Application Temperature Range;
- Ambient and Surface Temperature Requirements;
- Weather limitations;
- Precautions; and
- All other requirements necessary for successful application and satisfactory performance.

Do not place materials before furnishing complete instructions to the Project Manager.

- D. Surface and Temperature Requirements.** Prepare the surface before application and apply the marking material meeting the manufacturer's recommendations.

Meet the following unless otherwise recommended by the manufacturer:

1. Apply the material when ambient air and pavement surface temperature is at least 60 °F (16 °C).
2. Ensure the pavement surface, including grooved pavement for inlay applications, is dry during application.

The Inspector will perform a visual sight and touch inspection to ensure the surface is free of moisture. If a question exists concerning the pavement dryness, the following test may be performed. Tape a piece of aluminum foil, roofing paper, or clear plastic wrap to the pavement surface. Wait approximately 15 minutes. Do not apply markings if moisture appears beneath the material.

- E. Temperature Monitoring and Heating Equipment.** Equip melting and application equipment for marking material with permanently attached, easily read thermometers that provide a true, continuous, representative temperature of the material.

Use a heating kettle that provides indirect heat to melt the marking material.

Ensure the pre-melting kettles have rotating agitators that stir the marking material during heating.

- F. Surface Preparation.** Follow the manufacturer's surface preparation instructions.
- G. Primer/Sealer.** Follow the pavement marking manufacturer's recommendations for primer/sealer application. If no recommendations are made, apply a thin, uniform coat of SS-1 or CSS-1 on the pavement surface and grooved areas before applying the pavement marking. Insure the emulsion has broken before application of the pavement markings.
- H. Application.** Apply thermoplastic pavement markings a minimum of 30 calendar days, and a maximum of 45 calendar days, after seal coat operations through sweeping are completed. When thermoplastic pavement markings are the only remaining item of work on the project, contract time assessment will be suspended until either, beginning thermoplastic pavement marking application, or 45 calendar days elapse after seal coat operations are completed.

**TABLE 620-1**  
**THICKNESS OF INLAID THERMOPLASTIC MARKINGS**

THICKNESS	
400 Mils (10 mm)	275 Mils (7 mm)
Words and Symbols	Median Borders
Crosswalks	Continuous Centerline
Stop Bars	Dashed Centerline
8" White Lane Lines	Dashed Lane Lines
Dotted or Skip Lines	Shoulder Lines

Produce thermoplastic markings having straight and uniform edges that adhere to the pavement.

Finish the extruded lines, including words and symbols at least 1/4 inch (6 mm) wider than the groove widths at each edge and within the ranges shown in Table 620-2.

**TABLE 620-2**  
**ALLOWABLE MARKING WIDTH/GROOVE WIDTH**  
**TOLERANCE RANGES**

SPECIFIED WIDTH inches (mm)	GROOVE WIDTH inches (mm)	FINISHED MARKING WIDTH <sup>1</sup> inches (mm)
4 (100)	3 1/2-4 (90-100)	4-4 1/2 (100-115)
8 (205)	7 1/2-8 (190-205)	8-8 1/2 (205-215)
24 (610)	23 1/2-24 (600-610)	24-25 1/2 (610-650)

Notes:

1. Ensure the finished marking does not exceed 1/4-inch (6 mm) wider than the finished width.

Match the FHWA manual "Standard Alphabets For Highway Signs and Pavement Markings" for words and symbols. Produce the markings within 1/4 inch (6 mm) per 4 inches (100 mm) of width.

Use templates to extrude words and symbols that are larger than the grooves and meet the tolerance ranges in Table 620-2 to provide the required edge sealing.

Clean the grooves before placing the thermoplastic material. Meet the surface requirements in Subsection 620.03.5(D).

Apply thermoplastic material in grooves within 24 hours of grooving.

Keep traffic out the grooves and re-clean them as necessary before applying the thermoplastic material.

- I. Glass Bead Application.** Apply glass beads by drop-on methods immediately after the thermoplastic material application meeting Subsection 620.03.5(H) requirements.

Apply glass beads using at least 6 pounds per 100 square feet (0.30 kg per square meter) of thermoplastic material. The Project Manager may increase the glass bead application rate.

- J. Marking Protection.** Protect the thermoplastic pavement markings from traffic until it has set as specified in Article 4.3.2 of AASHTO M 249.

- K. Markings - Dimensional Tolerances.** Finish the markings to the specified minimum cross sectional hardened thickness.

Trim lines, words, and symbols to produce sharp, neat lines on all sides and ends.

Meet a linear tolerance of plus or minus 6 inches (155 mm) over each cycle on specified broken-line patterns.

Meet Table 620-2 tolerances for finished line widths.

- L. Joints.** Meet the following requirements for joints in the finished extruded thermoplastic markings:

1. Extrude transverse markings full width with a maximum of one transverse joint per length of line.
2. Apply words and symbols free of joints within each symbol, letter, or numeral. Letters made with one or more straight legs (A, L, N, T, etc.) and combination arrows (through and right or through and left, etc.) may be applied with one pass per leg. Combination arrows may be applied with one pass for each arrowhead of the marking.
3. Extrude 4-inch and 8-inch (100 mm and 205 mm) longitudinal lines full width in one pass with no transverse joints. Transverse joints are acceptable only for lines exceeding 100 feet (30.5 m) in length and lines shorter than 100 feet (30.5 m) that require a change of direction in the application equipments path.
4. Extrude lines 24 inches (610 mm) wide full width in one pass with a maximum of one transverse joint per length of line.

Finish joints to form neat lines without gaps or unevenness and that are moisture proof.

- M. Patching and Repairing.** Use material from the same batch of thermoplastic material used in the original work. The patching or repair may be performed mechanically or manually. Re-apply the beads as specified. Meet all specified dimensional tolerances and match the original lines.

- N. Cleaning and Trimming of Markings.** Remove irregularities in finished markings without chipping, cracking, or other damage to the markings or causing delaminations or separations between the pavement and marking material. Follow the manufacture's recommendations for marking cleaning and trimming. Do not damage the pavement or thermoplastic material.

### 620.03.8 Pavement Marking on Concrete Curbs

Clean the concrete surfaces meeting the paint manufacturer's recommendations. Do not apply pavement markings on concrete until 15 calendar days after the concrete has been placed.

Paint the tops and traffic sides of curbs at restricted parking locations as specified.

Apply yellow pavement markings to the tops and traffic sides of all island curbs, median curbs, and other similar curbs.

For estimating purposes, 100 feet (30.5 m) of curbing equals approximately 115 square feet (10.7 square meters) of curb surface to be painted.

#### **620.03.9 Marking Protection**

Protect markings until dry. Correct smeared or damaged markings at Contractor expense.

#### **620.03.10 Pavement Marking Removal**

Remove existing temporary and final pavement markings using any of the following:

- Sand blasting with air or water;
- High-pressure water;
- Steam or super-heated water; or
- Mechanically grinding, sanding, scraping, brushing.

Submit the method or methods to be used. The Contractor may submit written proposals for other removal methods. An approved method may be subsequently disapproved if it damages the marking surface or inadequately removes existing markings.

Remove sand or other material on the surface left by the removal as the work progresses.

Satisfactorily repair surfaces damaged by marking removal at Contractor expense.

### **620.04 METHOD OF MEASUREMENT**

#### **620.04.1 Temporary and Interim Pavement Marking Quantities**

Temporary pavement markings are measured by the mile (kilometer) to the nearest 0.1 mile (0.1 kilometer).

Interim pavement markings are measured by the gallon (liter) to the nearest whole gallon (liter).

Only those pavement markings represented by a Manufacturer's Material Certification at the time of application, and actually used and witnessed on the project are eligible for payment.

#### **620.04.2 Epoxy Pavement Markings**

Epoxy pavement markings are measured by the gallon (liter) to the nearest whole gallon (liter). Only those pavement markings represented by a Manufacturer's Material Certification at the time of application, and actually used and witnessed on the project are eligible for payment.

Should the actual quantity measured by the Project Manager using tank stabs or totalizer exceed the quantity calculated using an application rate of 22 mils times the width and length of line applied, the lesser quantity will be paid for.

#### **620.04.3 Preformed Plastic and Thermoplastic Pavement Markings**

Preformed plastic and thermoplastic pavement striping are measured by the foot (meter) to the nearest 0.1 foot (0.1 meter).

Words and symbols are measured by the square foot (square meter) to the nearest 0.3 square feet (0.1 square meter).

#### **620.04.4 Painted Pavement Markings and Curbs**

Painted pavement striping, words and symbols, stop bars, crosswalks, hash marks, and other striping not applied by a striping truck are measured by the gallon (liter) to the nearest whole gallon (liter). Painting curb is measured by the gallon (liter) to the nearest whole gallon (liter).

Quantity measurements are based on flow meter/totalizer readings taken before and after each run or if a calibrated tank is used, tank measurements are taken before and after each run. Computerized quantity print outs will be compared against tank stabs.



The amount of paint measured for payment is the difference between the start up readings and the end readings. All readings that measure paint for payment will be taken by the Project Manager. Provide all necessary assistance to make the readings including sufficient notice before the paint work begins.

#### **620.04.5 Removal of Pavement Markings**

Pavement striping removal is measured by the foot (meter) based on a 4-inch (100 mm) width, measured to the nearest whole foot (0.1 meter) for the actual quantity of striping removed. Lines wider and narrower than 4 inches (100 mm) are converted to the equivalent linear feet (meter) of 4-inch (100 mm) wide line.

Removal of words and symbols is measured by the square foot (square meter) to the nearest whole square foot (0.1 meter) and converted to the equivalent linear feet (meter) of 4-inch (100 mm) wide line.

#### **620.04.6 Line Control**

Establishing line control for pavement markings is not measured for payment.

#### **620.05 BASIS OF PAYMENT**

Payment for the completed and accepted quantities is made under the following:

<b><u>Pay Item</u></b>	<b><u>Pay Unit</u></b>
Preformed Plastic/ Thermoplastic	
Pavement Striping	Foot (meter)
Preformed Plastic/Thermoplastic Markings	Square Foot (square meter)
Truck-applied Painted Pavement Markings	Gallon (liter)
Words, Symbols, Stop Bars, Hash Marks	Gallon (liter)
Painted Curb Markings	Gallon (liter)
Temporary Pavement Markings	Mile (kilometer)
Interim Pavement Markings	Gallon (liter)
Remove Pavement Markings	Foot (meter) or Square Foot (square meter)

Line control is not paid for separately, but is included in the cost of the pavement markings.

Make a written request to the Project Manager to adjust the contract unit price of temporary and interim pavement markings when seasonal factors warrant a change in the material type from the original bid material. Furnish invoice prices that the bid was based on and invoice prices for the material furnished and applied.

Interim stripe applied over temporary stripe is measured and paid for as interim stripe.

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.



## **SECTION 621**

### **REMOVE, RESET, AND ADJUST FACILITIES**

#### **621.01 DESCRIPTION**

This work is removing, resetting, or adjusting facilities and items as specified.

#### **621.02 MATERIALS**

Use the materials specified in the contract. Materials not specified and used in the work must be equal and comparable to those found in the existing work.

Obtain the Project Manager's approval before using material substitutions.

#### **621.03 CONSTRUCTION REQUIREMENTS**

Be responsible for the condition and care of each facility from the time removal starts until resetting is completed.

Do not damage facilities when removing and resetting.

Lower or raise existing manholes, catch basins, inlets, water valve boxes, gas and water shut-offs, and similar structures to grade as specified or directed. Make adjustments without damaging adjacent structures.

Construct masonry tops for manholes to the specified line and grade before placing the ring and cover.

Restore existing facilities to a structurally solid condition as specified.

Make height adjustments to water valve boxes without using an extension if possible.

Adjust manholes, catch basins, inlets, water valve boxes, and other similar structures to temporary grade before placing base course material. Make final adjustment of structures to match the grade of the new pavement. Replace and set to grade cast iron rings and covers once the pavement is placed.

Backfill around structures meeting Section 604 requirements.

Backfill holes left by removed facilities.

Reusable materials from removed structures or facilities may be used to rebuild the work. Stockpile all removed material not reused as specified. The material is the facility owner's property.

#### **621.04 METHOD OF MEASUREMENT**

Remove, reset, and adjust facilities is measured by the unit.

#### **621.05 BASIS OF PAYMENT**

The item description for Remove and Reset is abbreviated to Reset.

Payment for the completed and accepted quantities is made under the following:

<u><b>Pay Item</b></u>	<u><b>Pay Unit</b></u>
Reset Facilities	Each

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.



## SECTION 622

### GEOTEXTILES

#### 622.01 DESCRIPTION

This work is furnishing and installing geotextiles.

#### 622.02 MATERIALS

Furnish materials meeting the following Subsection requirements:

Separation Geotextile .....	716.1 and 716.2
Stabilization Geotextile .....	716.1 and 716.3
Subsurface Drainage Geotextile Filter .....	716.1 and 716.4
Permanent Erosion Control Geotextile .....	716.1 and 716.5
Temporary Silt Fence Geotextile .....	716.6

##### 622.02.1 Classification

A geotextile is defined as any permeable polymeric textile used with foundation, soil, rock, earth, or any other geotechnical engineering related material, as an integral part of a civil engineering project, structure, or system.

**A. Separation/Stabilization Geotextile.** Use to prevent mixing of a subgrade soil and an aggregate cover material.

**1. Separation Geotextile.** Use separation geotextile for unsaturated firm subgrade conditions.

**2. Stabilization Geotextile.** Use stabilization geotextile for soft, wet, saturated subgrade conditions.

**B. Subsurface Drainage Geotextile Filter.** Use against soil to allow long-term passage of water into a subsurface drain system while retaining the in situ soil.

**C. Permanent Erosion Control Geotextile.** Use as a filter between energy absorbing armor systems (riprap) and the in situ soil to prevent soil erosion and hydraulic uplift pressures.

**D. Silt Fence.** Use between the edge of construction disturbance and a water resource, and at a critical resource or right-of-way line that is adjacent to construction activity. Use silt fence to assist in sediment control by retaining some of the eroded soil particles and slowing the runoff velocity to allow particle settling.

##### 622.02.2 Source Approval

Submit the following information regarding each geotextile proposed for use:

- Manufacturer's name and current address;
- Full product name/number;
- Geosynthetic material and structure; and
- Proposed geotextile use(s).

Submit a sample to the Project Manager for evaluation. Product acceptance is determined by comparing the average test results of all specimens within a given sample to the Minimum Average Roll Values (MARV) listed in Section 716.

Install geotextiles only after the material has been tested and accepted. Replace all geotextiles installed prior to acceptance that do not meet specifications at Contractor's expense.

### 622.02.3 Sampling

Cut a sample from the geotextile roll with the minimum dimensions of 4 feet (1.2 m) by the full width of the roll beyond the first wrap. After the sample and the required information have been submitted to the Project Manager, allow 30 calendar days for evaluation.

### 622.02.4 Identification, Shipment and Storage

Conform to ASTM D 4873, *Standard Guide for Identification, Storage, and Handling of Geotextiles*. Clearly label each roll of geotextile shipped to the project with the name and address of the manufacturer, full product name/number, quantity, and roll number. Submit a manufacturer's certificate of compliance signed by an authorized manufacturer's official. The certificate must attest that the geotextile meets all the Minimum Average Roll Value (MARV) requirements specified in Section 716 as evaluated under the manufacturer's quality control program.

The Project Manager will reject materials that are mislabeled or misrepresented.

Wrap each roll with a material that protects the geotextile, including ends of the roll, from damage due to shipment, water, sunlight, and contaminants. Maintain the protective wrapping during periods of shipment and storage.

Do not damage the geotextile or wrapping when unloading or transferring from one location to another. Do not drag the rolls.

During storage, elevate geotextile rolls off the ground and adequately cover to protect them from the following:

- Site construction damage;
- Precipitation;
- Ultraviolet radiation including sunlight;
- Chemicals that are strong acids or strong bases;
- Flames including welding sparks, temperatures in excess of 140 °F (60 °C); and
- Mud, dirt, dust, debris and any other environmental condition that may damage the physical property values of the geotextile.

## 622.03 CONSTRUCTION REQUIREMENTS

### 622.03.1 General

Prepare the surface on which the geotextile is to be placed so that no damage occurs to the geotextile. Do not drive construction equipment on the geotextile. Dispose of material with defects, rips, holes, flaws, deterioration, or other damage. Do not use defective material in the work.

If sewn seams are used for seaming the geotextile, use thread that consists of high strength polypropylene or polyester. Do not use nylon thread. For erosion control applications, use thread that is resistant to ultraviolet radiation. Use thread that is of contrasting color to that of the geotextile itself.

For seams that are sewn in the field, provide at least a 10-foot (3 meter) length of sewn seam for sampling by the Project Manager before the geotextile is installed. For seams that are sewn in the factory, provide samples as directed and witnessed by the Project Manager at random from any roll of geotextile that is used on the project.

For seams that are field sewn, use the same equipment and procedures for both the sampling and production seams. If seams are to be sewn in both the machine and cross-machine direction, provide samples of seams from both directions.

Submit the seam assembly description along with the sample of the seam. Include in the description the seam type, stitch type, sewing thread, and stitch density.

**622.03.2 Separation/Stabilization Geotextile**

Prepare the installation site by clearing, grubbing, and excavating or filling the area to the design grade. This includes removal of topsoil or vegetation. The Project Manager will identify soft spots and unsuitable areas during site preparation. Excavate these areas and backfill with approved granular material and compact as specified. Grade the area to be covered by the geotextile to a smooth, uniform condition, free from ruts, potholes, and protruding objects such as rocks or sticks.

Spread the geotextile immediately ahead of the covering operation. Lay the geotextile smooth without wrinkles or folds on the prepared subgrade in the direction of construction traffic. Remove wrinkles and folds by pulling the geotextile taut as required. Use soil piles or the manufacturer's recommended method (as approved by the Project Manager) to hold the geotextile in place until the specified cover material is placed. Overlap, sew or join adjacent geotextile rolls and roll ends as shown on the plans or as directed by the Project Manager. Overlap in the direction shown on the plans. Overlap in accordance with the requirements of Table 622-1, or as specified on the plans or in the special provisions.

**TABLE 622-1  
OVERLAP REQUIREMENTS**

<b>UNDRAINED SHEAR STRENGTH OF SUBGRADE</b>	<b>MINIMUM OVERLAP</b>
> 2,000 psf (> 95 kPa)	1 foot (0.3 m)
500-2,000 psf (25-95 kPa)	3 feet (0.9 m) or Sewn
< 500 psf (< 25 kPa)	Sewn
All roll ends	3 feet (0.9 m) or Sewn

On curves, cut or fold the geotextile to conform to the curve. Fold or overlap in the direction of construction and hold in place using pins, staples, or piles or fill or rock.

Do not cover the geotextile until inspected for damage by the Project Manager. Repair or replace all damaged geotextile at Contractor's expense. Make repairs following the manufacturer's recommendation or use a patch of the same material placed over the damaged area, overlapped at least 3 feet (0.9 m) from the edge of any part of the damage. Sewing repairs are an acceptable alternative.

Place fill over the geotextile by dumping onto previously placed material and pushing the material into place. Do not operate any construction equipment directly on the geotextile under any circumstances. Place the fill material in uniform layers so that there is the minimum specified lift thickness between the geotextile and equipment tires or tracks at all times. The minimum thickness of the first lift is 8 inches (200 mm). Do not allow construction equipment to turn on the first lift of material above the geotextile. Do not blade the first lift placed over the geotextile. If the subgrade is very soft with an undrained shear strength less than 500 psf (25 kPa) minimize pile heights to less than 3 feet (0.9 m) and spread piles as soon as possible after dumping to minimize the potential for localized subgrade failure due to overloading of the subgrade.

Do not use sheepsfoot or studded compaction equipment on the first lift placed over the geotextile. Stop vibrator on compaction equipment if pumping occurs. Do not operate any construction equipment that results in rutting in excess of 3 inches (75 mm) on the first lift. If rutting exceeds 3 inches (75 mm), decrease the construction equipment size and/or weight or increase the lift thickness. Use only rubber-tired rollers for compaction if any foundation failures occur when placing subsequent lifts. Compact all lifts to the moisture and density requirements for earth embankment specified in Subsection 203.03.3. Do not blade material down to remove ruts. Fill any ruts or depressions with additional material and compact to the specified density.

**622.03.3 Subsurface Drainage Geotextile Filter**

Excavate trench in accordance with the project plans. Do not allow large voids to occur in the sides and bottom of the trench. Grade the surface to be smooth and free of debris.

Place the geotextile loosely with no wrinkles or folds, and with no void space between the geotextile and the ground surface. Press the geotextile into the corners of the trench. Overlap successive sheets of geotextiles a minimum of 1 foot (0.3 m), with the upstream sheet overlapping the downstream sheet.

Place a sufficient width of geotextile to entirely cover the perimeter of the trench and allow for the required overlap. In trenches equal to or greater than 1-foot (0.3 m) width, after placing the drainage aggregate, fold the geotextile over the top of the backfill material in a manner to produce a minimum overlap of 1 foot (0.3 m). In trenches less than 1 foot (0.3 m) wide, but greater than 4 inches (0.1 m) wide, overlap the geotextile the entire width of the trench. Where the trench is less than 4 inches (100 mm) wide, sew or otherwise bond the geotextile in accordance with the manufacturer's recommendations, as approved by the Project Manager. All seams will be subject to the approval of the Project Manager.

If the geotextile is damaged during installation or aggregate placement, place a geotextile patch over the damaged area extending beyond the perimeter of the damaged area a distance of 1 foot (300 mm) or the specified seam overlap, whichever is greater.

Place the drainage aggregate immediately following geotextile placement. Cover the geotextile with a minimum of 12 inches (300 mm) of loosely placed aggregate prior to compaction. If a perforated collector pipe is to be installed in the trench, place a minimum of a 6 inch (150 mm) bedding layer of drainage aggregate below the pipe, with the remainder of the aggregate placed to the minimum required construction depth.

Compact all placed aggregate to a minimum of 95 percent of the maximum standard Proctor density determined in accordance with MT-210.

**622.03.4 Permanent Erosion Control Geotextile**

Place the geotextile on a smooth graded surface approved by the Project Manager. Place the geotextile loosely and anchor it in place with sand bags, soil piles, or steel pins. Place the geotextile in such a manner that placement of the riprap does not stretch or tear the geotextile. Place the riprap from the bottom of the slope up to the top of the slope. After placement of the riprap, key the geotextile at least 18 inches (450 mm) into the ground at the top of the embankment. Do not key the geotextile in until all of the riprap has been placed on the slope. Secure the geotextile at the toe by lapping the material back and securing with riprap.

Limit atmospheric exposure to a maximum of 14 days following lay down to minimize damage potential.

Place the geotextile with the machine direction parallel to the direction of water flow, which is normally parallel to the slope (downslope) for erosion control runoff and wave action, and parallel to the stream or channel in the case of streambank and channel protection. Join adjacent geotextile sheets by either sewing or overlapping. Overlap seams of roll ends a minimum of 1 foot (300 mm) except where placed under water or on slopes 3:1 or steeper. Overlap seams of roll ends placed under water or on slopes 3:1 or steeper a minimum of 3 feet (900 mm). Overlap adjacent rolls a minimum of 1 foot (300 mm) in all instances. For slopes flatter than 3:1, use pins or staples to hold the overlap in place during placement of riprap. Pin the geotextile loosely so it can easily conform to the ground surface and give when riprap is placed. Do not use pins at overlaps for slopes 3:1 or steeper.

Overlap successive sheets of the geotextile upstream over downstream, and/or upslope over downslope. In cases where wave action or multidirectional flow is anticipated, sew all seams perpendicular to the direction of flow.



Avoid damaging the geotextile as a result of the installation process. If the geotextile is damaged during installation, place a patch over the damaged area extending a minimum of 3 feet (900 mm) beyond the perimeter of the damaged area.

Begin riprap placement at the toe and proceed up the slope. Avoid stretching and subsequent tearing of the geotextile. Do not drop riprap and heave stone from a height of more than 1 foot (300 mm). Do not allow stones weighing more than 200 lbs (90 kg) to roll down the slope.

Do not drop slope protection and smaller sizes of stone material from a height exceeding 3 feet (900 mm), unless the Project Manager approves the procedure following a demonstration showing the geotextiles are not damaged by the procedure.

In underwater applications, key the geotextile in at the bottom of the slope. Develop and demonstrate to the Project Manager a method of underwater placement to secure the geotextile in place without damaging the geotextile. Place the geotextile and the backfill material in the same day. Backfill all void spaces in the riprap with smaller stone to ensure full coverage of the geotextile.

After placement of the riprap, no grading of the slope is allowed if it results in movement of the riprap directly above the geotextile.

Replace any geotextile damaged during backfill placement as directed by the Project Manager at the Contractor's expense.

#### **622.03.5 Silt Fence**

Install silt fence in accordance with this specification and with the Detailed Drawings. The maximum cut or fill slope for a silt fence is 2:1 (horizontal: vertical). For cut or fill slopes steeper than 2:1, use alternative methods of soil stabilization Best Management Practices (BMPs).

Use fence posts having a minimum length of 48 inches (1220 mm). Drive fence posts a minimum of 18 inches (450 mm) into the ground. Use fence posts having a sufficient strength to resist damage during installation and to support the applied loads due to material build up behind the silt fence.

There are two types of silt fence installations:

- 1. Unstabilized.** Silt fence supported with either wood or metal fence posts.
- 2. Stabilized.** Silt fence supported with metal posts and with woven wire backing.

For stabilized silt fence, use woven wire having a maximum of 6-inch (150 mm) mesh spacing and a minimum of 14.5 gauge wire.

Excavate a trench at least 6 inches (150 mm) wide by 6 inches (150 mm) deep at the base of the silt fence. The vertical entrenchment component consists of burying the silt fence a minimum of 6 inches (150 mm) below the ground surface. Vertical and horizontal entrenchment of the silt fence consists of placing the silt fence in a "J" configuration in the trench extending a minimum of 6 inches (150 mm) below the ground surface and a minimum of 6 inches (150 mm) horizontally along the bottom of the trench. The initial silt fence installation requires only the vertical entrenchment component unless the Project Manager determines both vertical and horizontal entrenchment components are necessary. If the fence requires replacement due to failure from pullout or undercutting, the subsequent entrenchment must include both vertical and horizontal entrenchment components in a "J" configuration. Backfill the trench with the excavated material and compact.

Splice the geotextile with a sewn seam or overlap two sections of fence in accordance with the detailed drawings.

Place the posts at a minimum spacing of 4 feet (1.2 m) and at a maximum spacing of 8 feet (2.4 m). Securely fasten the silt fence geotextile to the upslope side of the fence post.

Place silt fence continuous and transverse to the flow. Follow the contours of the site as closely as possible. Place the fence so that water cannot run off and around the end of the fence.

Inspect all temporary silt fences immediately after each rainfall and at least daily during prolonged rainfall. Immediately correct any deficiencies at the Contractor's expense.

Make a daily review of the location of silt fences in areas where construction activities have altered the natural contour and drainage runoff to ensure that the silt fences are properly located for effectiveness. Where deficiencies exist as determined by the Project Manager, install additional silt fence as directed by the Project Manager.

Repair or replace damaged silt fence promptly.

Remove sediment from behind the silt fence when it occurs to one-third the original height.

Leave the silt fence in place until the Project Manager directs to remove it. Either grade and seed, or remove the sediment deposits prior to removal of the fence.

#### **622.04. METHOD OF MEASUREMENT**

Geotextiles are measured by the square yard (square meter) as staked by the Project Manager, except silt fence, which is measured by the yard (meter) of fence. Measurement excludes laps, seams, and joints.

#### **622.05. BASIS OF PAYMENT**

Payment for the completed and accepted quantities is made under the following:

##### **Pay Item**

Geotextile, Separation/Stabilization  
 Geotextile Filter, Subsurface Drainage  
 Geotextile, Erosion Control  
 Geotextile, Silt Fence

##### **Pay Unit**

Square Yard (square meter)  
 Square Yard (square meter)  
 Square Yard (square meter)  
 Yard (meter)

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.

## **SECTION 623**

### **MAILBOXES**

#### **623.01 DESCRIPTION**

This work is the furnishing and installation of mailboxes and crash-worthy supports at the specified locations or as directed.

#### **623.02 MATERIALS**

Furnish Rubbermaid™ rubberized mailboxes, measuring at least 6 1/2 inches wide x 7 1/2 inches high x 18 1/2 inches long (165 mm x 190 mm x 470 mm), not exceeding 13 pounds (5.9 kg) in weight that meet the Postal Service requirements.

Furnish a crashworthy mailbox support as shown in the Detailed Drawings, a mailbox support identified in the current edition of the AASHTO *Guide for Erecting Mailboxes on Highways*, or other commercially manufactured crash tested mailbox support.

#### **623.03 CONSTRUCTION REQUIREMENTS**

Install the mailbox and support meeting the contract requirements.

#### **623.04 METHOD OF MEASUREMENT**

The mailbox and its support are measured as a unit.

#### **623.05 BASIS OF PAYMENT**

Payment for the completed and accepted quantities is made under the following:

<b><u>Pay Item</u></b>	<b><u>Pay Unit</u></b>
Mailbox	Each

Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract.

